21st CENTURY ORNITHOLOGY

CHALLENGES
OPPORTUNITIES
DECISIONS

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2018 ANNUAL CONFERENCE

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27–29 MARCH 2018

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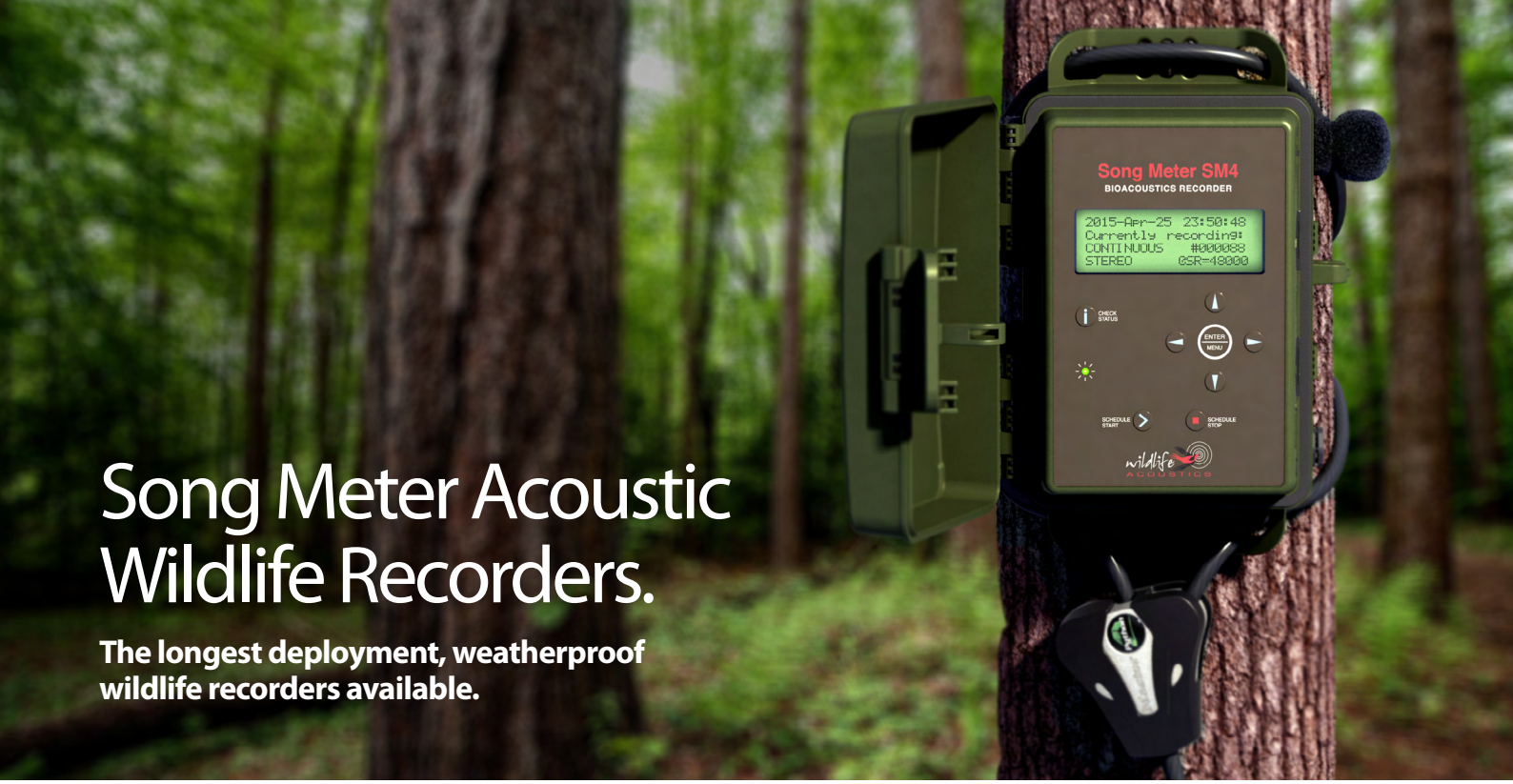

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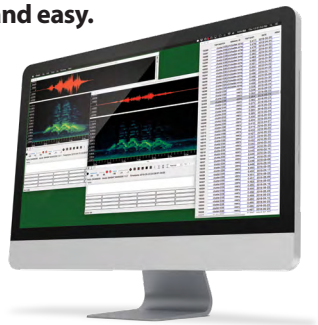

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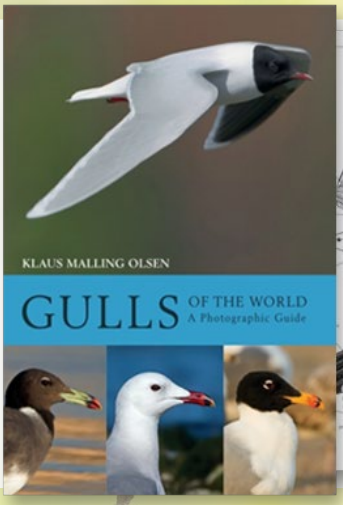

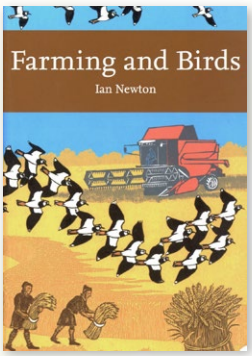

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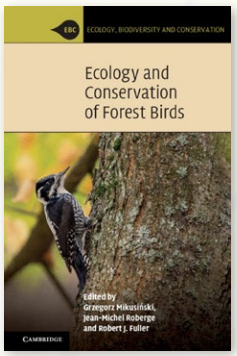

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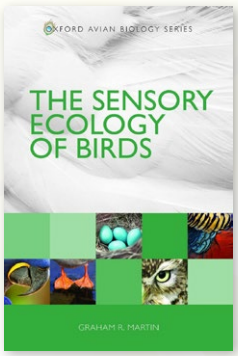

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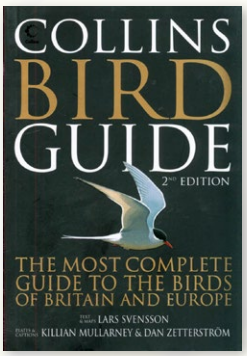

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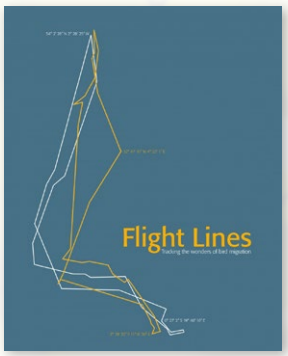

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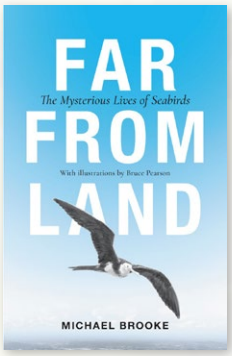

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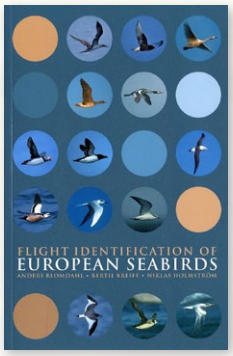

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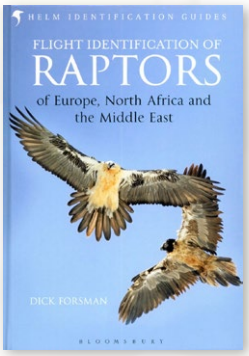

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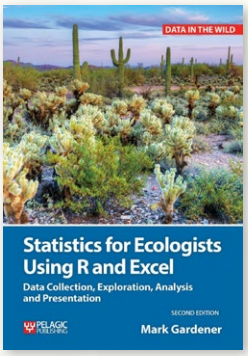

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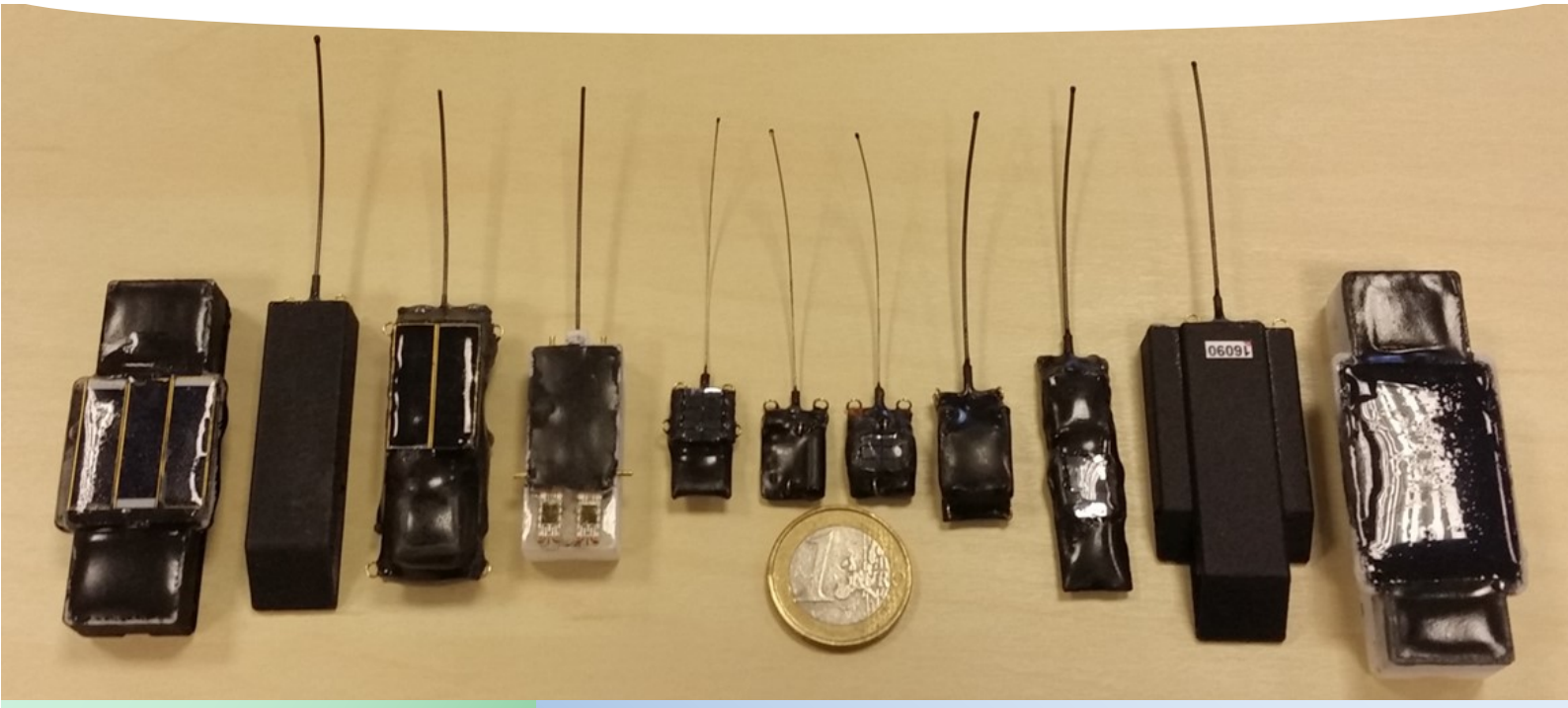

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The **British Ornithologists' Union** (BOU)**,** founded in 1858 by Professor Alfred Newton FRS, is one of the world's oldest ornithological bodies. The BOU's aim is to promote ornithology and a better understanding of ornithology, birds and related issues, within the scientific and birdwatching communities.

To help achieve this aim, the BOU organises meetings, seminars and conferences at which ornithologists and others can discuss and learn more about work being undertaken around the world and topical ornithological issues.

The BOU has been organising conferences and meetings for over 100 years, and they provide an opportunity for people, from widely differing professional backgrounds, to explore and relate to a discrete scientific theme of common interest. Recent topics have included *Birds in upland and alpine habitats, Avian Food webs, Ecosystem Services: do we need birds?, Avian Tracking, Avian Food-webs, Ecosystem Services, Migratory Birds, Birds and Disturbance*, *Renewable Energy and Birds*, *Lowland Farmland Birds* and *Birds & Public Health*. Such meetings help to promote understanding of environmental issues and the sharing of knowledge, the presentation of contentious academic theories to critical public debate and the defence of such ideas lie at the heart of healthy science. The proceedings of many BOU conferences can be viewed for free online via WWW.BOUPROC.NET.

The BOU further achieves its aim by the quarterly publication of our international journal - *Ibis*. Established in 1859, *Ibis* - the world's leading ornithological journal - publishes work at the cutting edge of our understanding of the world's birdlife, be it behaviour, population dynamics, systematics, breeding biology, taxonomy, habitat use or conservation. IBIS is available in print and online – visit WWW.IBIS.AC.UK.

ACKNOWLEDGEMENTS
21st Century Ornithology: challenges, opportunities and decisions, a conference organised and delivered by Prof Bill Sutherland (Cambridge University), Dr Helen Baker (JNCC), Dr Darren Evans (Newcastle University), Dr Aldina Franco (University of East Anglia), Steve Dudley (BOU) and Angela Langford (BOU) on behalf of the British Ornithologists' Union. The BOU would like to thank Dr Cat Horswill (University of Glasgow), Nicola Crockford (RSPB), Graham Appleton (WaderTales), Prof Jenny Gill (University of East Anglia), Dr Jen Smart (RSPB Centre for Conservation Science), Paul Stancliffe (BTO) and Mike Toms (BTO) for organising and running the pre-conference early-career researcher (ECR) workshops.

The BOU is grateful to the individual speakers and their respective organisations for presenting their work at the conference.

CONFERENCE PROCEEDINGS
Abstracts, papers and other items from the oral and poster papers presented at the conference will be published online at WWW.BOUPROC.NET. Some presentations may appear as full papers in *Ibis* and will then be linked to from the conference abstract.

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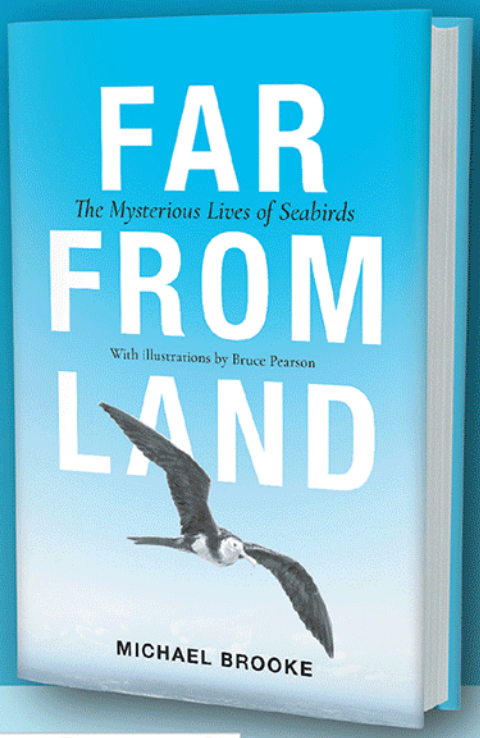

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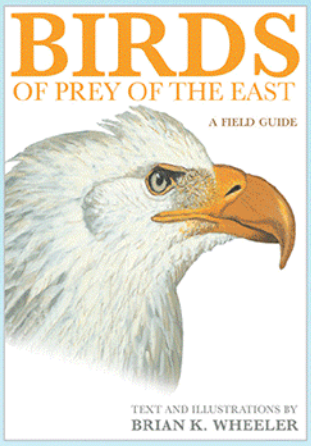

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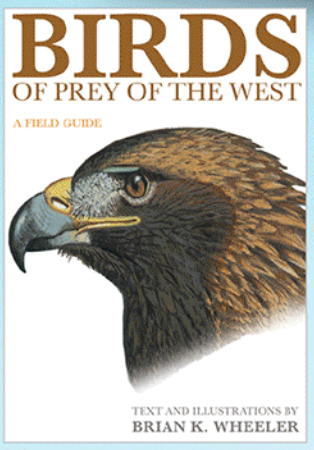

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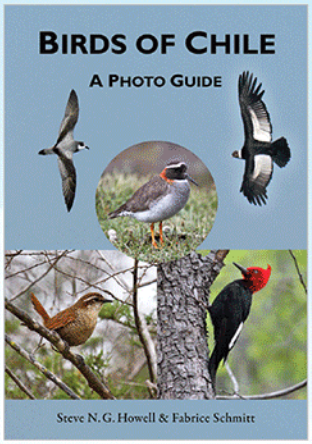

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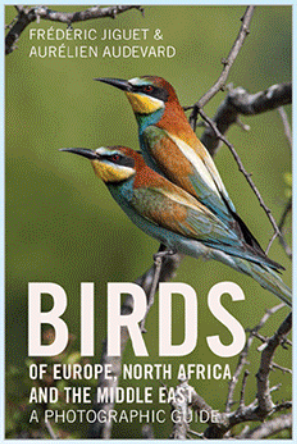

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Welcome to #BOU2018 – the BOU's 2018 Annual Conference

The annual BOU conference for 2018 is themed *21st century ornithology: challenges, opportunities and decisions*. This is a very timely and exciting conference topic, and we are delighted that it has attracted so many ornithologists from around the world.

Bird populations and distributions are under intense pressures from rapid environmental changes and increasing human impacts on ecosystems, and new methods and approaches are needed to understand and predict how different species will respond to these pressures. By exploring a range of challenges, this conference will examine the current state of the art in avian science in understanding and mitigating the threats to birds, and will encourage a forward examination of the likely changes in bird populations and communities up to 2050.

Over the coming days, ornithologists and ecologists from a wide range of academic and conservation organisations will explore the science evidence needed to provide guidance and to support decisions about how to maintain and restore global bird populations and communities, providing a unique opportunity to showcase examples of the research and science needed to address future challenges by looking several decades ahead.

Lastly, we try to make BOU conferences as welcoming as possible for everyone. Those attending a BOU conference for the first time have 'N E W' on their name badge, so please be especially welcoming to the new members our BOU family.

We very much hope that you enjoy the conference.

Prof. Keith Hamer | BOU President

Code of Conduct

We have always taken it for granted that BOU events are safe for all participants, but in light of difficulties experienced by other societies, we have drawn up this simple code for all BOU events.

We welcome everyone to BOU events, be these in person at our conferences, meetings and workshops, or online events such as Twitter conferences.

We work hard to engender and promote a welcoming environment that is collaborative, supportive and engaging for everyone involved. Our events provide opportunities to share, develop and broaden viewpoints in a safe and inclusive environment.

We celebrate diversity in all its forms and expect that all our participants are respectful and considerate of each other, that they provide supportive critique, and embrace the multitude of opinions that are on offer.

If you have any concerns, or feel that any participant of an event has breached this code, or have suggestions for how we can make our events more inclusive and productive, please contact any member of the BOU staff, BOU's Meetings Committee or event organisers (named contacts are listed in all event programmes).

During an event, please report any incident as soon as you feel able, to allow us to act upon your concerns. Any reports will be handled in confidence.

Your primary contacts for any issues that may arise during this conference are:

Helen Baker
BOU Honorary Secretary

Steve Dudley
BOU Chief Operations Officer

Angela Langford
BOU Journal & Office Manager

EVENTS

#BOUatIOC
20 August 18, Vancouver, Canada
Ecology and conservation of grassland birds

#BOUsci18
11 October 18, Peterborough, UK
Seabirds: towards a sustainable future with renewable energies

#BOU2019
26–28 March 19, University of Warwick, UK
'Tracking migration'

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PROGRAMME

Presenting authors are listed below. All authors of multiple-author papers are included within the abstracts. All talks will be in the main lecture hall (room A03).

TUESDAY, 27 MARCH 2018

1700 Registration opens

1700 – 2200 Time to view posters and exhibitors/shops

1900 **DINNER** (Cavendish Hall)

2030 **Welcome** | Keith Hamer | BOU President | University of Leeds, UK | @KeithCHamer

ALFRED NEWTON LECTURE

The role of bird data and science in conservation management and policy: what information really counts?

Hugh Possingham | The Nature Conservancy & University of Queensland, Australia | @hugepossum

– 2200 Time to view posters, exhibits, shops and displays (foyer and room A02)

– 0000 **BAR** (Cavendish Hall)

WEDNESDAY, 28 MARCH 2018

0730 **BREAKFAST** (Cavendish Hall)

0830 Registration opens

0900 **Conference opening**

Keith Hamer | BOU President | University of Leeds, UK

SESSION 1 **GLOBAL CHANGES AND MIGRATORY SYSTEMS**

Chair: Keith Hamer | BOU President | @KeithCHamer
University of Leeds, UK

0905 **KEYNOTE**

Consequences of individual movement strategies

Jenny Gill | University of East Anglia, UK | @jengill3

0935 **Seasonal niche overlap as a measure of migratory bird's flexibility to the global change**

Guillermo Fandos | Universidad Complutense de Madrid, Spain | @gfandos

0950 **Fuelling conditions at staging sites can mitigate Arctic warming effects in a migratory bird**

Eldar Rakhimberdiev | NIOZ Royal Netherlands Institute for Sea Research, the Netherlands

1005 **Predicting the individual- and population-level effects of land use changes on three species of overwintering swan (Cygnus spp.)**

Kevin A. Wood | Wildfowl & Wetlands Trust, UK | @drkevinwood

WEDNESDAY, 28 MARCH 2018 (CONT)

1020 **Does warming along migration routes explain the advancement of spring arrival in long distance migrants?**
Mark Eddowes | Independent Researcher, UK

1035 **SPEEDY POSTERS**
Each poster author has just 30 seconds to introduce their work – it's fast and it's fun!

1050 **COFFEE**
Time to view posters, exhibits, shops and displays (foyer and room A02)

SESSION 2 **INVASIVE SPECIES AND RESILIENCE**
Chair: Jen Smart | Chair, BOU IBIS Management Committee | @drredshank
RSPB Centre for Conservation Science, UK

1130 **KEYNOTE**
Patterns of alien species: future scenarios and consequences for birds
Tim Blackburn | University College London, UK | @TimBLackburn66

1200 **Codispersal services by waterbirds: implications for expansion of alien species and redistribution of native species under climate change**
Andy Green | Estación Biológica de Doñana, Spain | @drAndyGreen

1215 **Prioritising wetland conservation by quantifying resistance and resilience to extinction among papyrus-endemic birds in East Africa**
Lynda Donaldson | University of Exeter, UK | @donaldsonlynda1

1230 **Convergent evolution connects form to function in the world's birds**
Joseph Tobias | Imperial College London, UK | @ja_tobias

1245 **LUNCH** (Cavendish Hall)
Time to view posters, exhibits, shops and displays (foyer and room A02)

SESSION 3 **RESPONDING TO CLIMATE CHANGE**
Chair: Cat Horswill | BOU Conference Support Officer | @catrsw
University of Glasgow, UK

1415 **KEYNOTE**
Habitats in a changing climate: population impacts and implications for conservation
Malcolm Ausden | RSPB, UK

WEDNESDAY, 28 MARCH 2018 (CONT)

1445 **Evidence for contrasting climate change impacts at different life history stages in the Mauritius Kestrel**
Joseph Taylor | University of Reading, UK

1500 **Implications of increasing hurricane intensity: sensitivity to catastrophic disturbance among bird guilds in a Mexican wetland**
Matthew Ruiz | El Colegio de la Frontera Sur, Mexico | @MatDMRuiz

1515 **Effects of climate change and land use intensity on laying dates and population growth rates of Black-tailed Godwits**
Rosemarie Kentie | University of Oxford, UK | @RoosKentie

1530 **Climate change impacts on seabird populations: latest evidence and future research priorities**
Francis Daunt | Centre for Ecology & Hydrology, UK | @CEHseabirds

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1545 **TEA**
Time to view posters, exhibits, shops and displays (foyer and room A02)

SESSION 4 **LAND USE CHANGE**
Chair: Darren Evans | Chair, BOU Meetings Committee | @DarrenMarkEvans
Newcastle University, UK

1630 **KEYNOTE**
The uplands – reflecting on change and challenging the challenges
Des Thompson | Scottish Natural Heritage, UK

1700 **From radio tags to drop-off GPS-loggers: new tracking technologies can improve the efficacy of conservation programs for Nightjars**
Ruben Evens | Hasselt University, Belgium | @REVNJ

1715 **How does native woodland restoration affect breeding bird communities?**
David Douglas | RSPB Centre for Conservation Science, UK | @davidjtdouglas

1730 **The World at our fingertips: how the Open Data Revolution is boosting opportunities for bird-habitat analyses**
Richard Broughton | Centre for Ecology & Hydrology, UK | @woodlandbirder

1745 **Presentations**

1800 **BOU AGM** (Lecture theatre, room A03)

1830 **BOU ECR EVENT** (rooms A21 and A22)

– 1945 Time to view posters, exhibits, shops and displays (foyer and room A02)

WEDNESDAY, 28 MARCH 2018 (CONT)

2000 **CONFERENCE DINNER** (Cavendish Hall)

– 0000 **BAR** (Cavendish Hall)

THURSDAY, 29 MARCH 2018

0730 **BREAKFAST** (Cavendish Hall)

0830 Registrations opens

SESSION 5 **MARINE PRESSURE AND RESPONSES**

Chair: Helen Baker | BOU Honorary Secretary & BOU2018 Programme Organising Committee JNCC, UK | @HelenBinP

0900 **KEYNOTE**

The times they are a changing: What does the future the hold for seabirds?

Beth Scott | University of Aberdeen, UK

0930 **How to use science to inform decision-making; the case of birds and renewable energy development**

Lucy Wright | RSPB Centre for Conservation Science, UK | @_LucyWright

0945 **Population and Individual responses to environmental variability**

Alice Trevail | University of Liverpool, UK | @AliceTrevail

1000 **Environmental change and carry-over effects determine productivity and phenology at a European Shag *Phalacrocorax aristotelis* colony over half a century**

Richard Howells | Centre for Ecology & Hydrology, UK | @howellsrj

1015 **Marine birds are in trouble**

Ian Mitchell | JNCC, UK

1030 **COFFEE**

Time to view posters, exhibits, shops and displays (foyer and room A02)

SESSION 6 **TECHNOLOGICAL ADVANCES**

Chair: Aldina Franco | BOU2018 Programme Organising Committee | @AldinaFranco University of East Anglia, UK

1115 **KEYNOTE**

Current advances in technology and future possibilities, and impacts on science, conservation and citizen science

Martin Wikelski | Max Planck Institute for Ornithology, Germany | @martinwikelski

THURSDAY, 29 MARCH 2018 (CONT)

1145 **Balancing Afrotropical biodiversity and agriculture through food web models and DNA metabarcoding**
Luke Powell | University of Glasgow, UK | @_Biodiversity

1200 **Infrared thermal imaging to assess physiological state in free-living birds**
Paul Jerem | University of Glasgow, UK

1215 **Application of Morphic-Google Images web tool for ornithological studies**
Arjun Amar | FitzPatrick Institute of African Ornithology, South Africa | @arjundevamar

1230 **Can drones count gulls?**
Matt Wood | University of Gloucestershire, UK | @wood_mj

1245 **LUNCH** (Cavendish Hall)
Last chance to view posters, exhibits, shops and displays (foyer and room A02)

1400 Voting for best ECR presentations closes

SESSION 7 **FUTURE ORNITHOLOGY**
Chair: Bill Sutherland | Chair, BOU2018 Programme Organising Committee | @Bill_Sutherland
University of Cambridge

1415 **#TheTweetingBird: its rise, relevance and impact in #ornithology**
Steve Dudley | BOU, UK | @stevedudley_

1430 **Predicting the response of British bird populations to future scenarios of land-use and food production**
Tom Finch | RSPB Centre for Conservation Science, UK | @tomfinch89

1445 **What role for agri-environment in 21st Century land bird conservation?**
Will Peach | RSPB Centre for Conservation Science, UK

1500 **KEYNOTE**
Changes in International Conservation issues
Juliet Vickery | RSPB Centre for Conservation Science, UK

1530 **Closing summary**
Bill Sutherland, University of Cambridge

Close of conference
Keith Hamer | BOU President | University of Leeds, UK

AFTERNOON TEA and departure

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ABSTRACTS

Abstracts for the oral programme are in programme order. Poster abstracts (page 49) are in surname alphabetical order.

TUES, 27 MARCH, 2030 h

ALFRED NEWTON LECTURE

The role of bird data and science in conservation management and policy: what information really counts?

Hugh Possingham
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We are repeatedly reminded that conservation is a crisis discipline. We know that extinction rates are maybe 1000 times the "background" rate and the overall abundance of birds is also in decline. For those of us interested in reducing the loss of birds, what is the role of science and monitoring? Can we afford the luxury of pure discovery and undirected monitoring in this time of crisis?
In this talk I will classify and illustrate the different ways in which bird science and data inform management and policy, from The Nature Conservancy and beyond. There are examples of spectacular success. I will introduce the idea of Value of Information Theory and argue that we can prioritise our research efforts much more tightly if we take a cost-effectiveness approach to deciding what research and monitoring will likely change management and policy for the greatest net benefit to bird conservation. Notably, the things we know least about are not necessarily the things that require most study. The simple question – "Explain in detail how the results of your study change how we act?" needs to be part of every applied research proposal. Some call this having a "theory of change".

WEDS, 28 MARCH, 0905 h

KEYNOTE

Consequences of individual movement strategies

Jenny Gill
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How will migratory birds respond to future changes in land use and climatic conditions? Our ability to predict such responses rests on our understanding of the links between environmental conditions and the demographic processes that can drive changes in population size and distribution. Many migratory species across the change are declining rapidly in number at present, creating an urgent need to identify potential conservation responses. While identifying causes of changes and appropriate conservation actions is complicated by the scales over which these species travel, and the range of environmental conditions that they can experience across the migratory range, rapid changes in phenology, demography and distribution are occurring in many migratory systems at present, and these can provide important clues about the mechanisms that drive these changes. In this talk, I will explore these changes and how they can help us to identify and target conservation actions.

Jenny Gill is Professor of Applied Ecology at the University of East Anglia. She has worked on a range of migratory systems, from waders and geese that migrate between subarctic and temperate ecosystems to Afro-Palaearctic migrants, and her work focusses on understanding the response of migratory species to environmental change.

WEDS, 28 MARCH, 0935 h

Seasonal niche overlap as a measure of migratory bird's flexibility to the global change

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An increasing number of studies have shown that distributions and population dynamics of animals are affected by climate change and human land use practices. Birds performing long-distance migrations are more vulnerable to ongoing climate change than residents and short-distance migrants, because of their complex annual cycle. However, population declines have not been

uniform across long-distance migratory species, implying that some species traits might confer particular sensitivity to environmental change. Migratory species differ in their abilities to respond to changes in the environmental spatial heterogeneity across seasons, hence seasonal niche overlap can be an indicator of general niche flexibility in migratory species under global change. In this study, we used the available data on occurrence of Palearctic long-distance migrants (eBird and range maps) in combination with the population trend European Bird Census Council; EBCC) and the phylogeny, to explore the link between seasonal niche overlap in bird species and their recent population trends. We explore this relationship between the seasonal niche overlap and the population trends using phylogenetic generalized least squares (PGLS) regressions. The results suggest that long-distance migratory passerines wintering in Sub-Saharan Africa with high niche overlap between seasons (niche trackers) experience greater declines in breeding population size following extreme climate and land use changes, than those species that inhabit different niches between seasons. Identifying the characteristics of long-distance migrants that increase susceptibility to global change is critical for implementing effective conservation measures to protect this threatened group of animals

Guillermo Fandos is a biologist with a main research focus on the understanding of the multiple environmental drivers that govern migratory bird's distributions along the year. He is particularly interested in the processes underlying large-scale biogeographic patterns and their relationships with the abiotic environment, and in consequences for global conservation.

WEDS, 28 MARCH, 0950 h

Fuelling conditions at staging sites can mitigate Arctic warming effects in a migratory bird

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As they cross latitudes, migratory birds utilize sequences of seasonally peaked resources. To cope with rapid warming in the Arctic and slower warming in the tropics, migratory birds have to adjust multiple components of the annual cycle at different rates. We show that despite this challenge, the need for multiple adjustments can actually offer the opportunity for change in one phase to be mitigated in another. We demonstrate this potential in bar-tailed godwits (*Limosa lapponica taymyrensis*) who travel 10 000 km from their wintering grounds in West Africa to the rapidly warming central Eurasian Arctic breeding grounds, with a single refuelling stop in the Wadden Sea in north-

western Europe. Using a 20-year time series of observations collected at wintering, refuelling and breeding areas, we show that godwits adjusted the time of breeding with the advancing phenology at the breeding grounds by shortening refuelling time in the Wadden Sea. However, to facilitate earlier departures to the breeding grounds with sufficient stores, refuelling godwits need better refuelling conditions than currently available. Rapid Arctic warming, in combination with ongoing development of coastal refuelling areas, will have synergistic negative effects on their already declining populations. At the same time our findings indicate that proactive management to improve refuelling conditions can mitigate Arctic-warming effects for these long-distance migrants.

Eldar Rakhimberdiev is a quantitative ecologist focused on full annual cycle population ecology of migratory animals. He studies how connected parts of annual cycles interact to mitigate effects of climate change and human imposed pressures on population dynamics. For that he develop statistical models, approaches and software.

WEDS, 28 MARCH, 1005 h

Predicting the individual- and population-level effects of land use changes on three species of overwintering swan (Cygnus spp.).

Kevin A. Wood[1], Richard A. Stillman[2], Julia L. Newth[1], Rascha J.M. Nuijten[3], Geoff M. Hilton[1], Bart A. Nolet[3,4] & Eileen C. Rees[1]

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As conservationists we need to predict how birds will respond to changes in their environment, and how such responses may be affected by conservation interventions. Calls for conservation to become more predictive have led to the development of models that base predictions on fitness maximization decision-rules, including individual-based models (IBMs). The decision rules of fitness-maximizing models are based on adaptive behaviour and so are not expected to change even if the environment changes. Thus these rules are considered more likely to maintain their predictive power as environmental conditions change than extrapolations of empirical correlative relationships.
We built and tested an IBM of three overwintering swan species at a key overwintering site in the UK; Bewick's Swans (*Cygnus columbianus bewickii*), Whooper Swans (*Cygnus cygnus*) and Mute Swans (*Cygnus olor*). Our model made predictions at both the individual- (e.g. behaviour, energy reserves)

and population-levels (e.g. population size). We compared these model predictions with real world data to validate our IBM using a Pattern Oriented Modelling approach. We used our validated model to forecast how expected future changes in land use, such as changes in crop types and the loss of feeding habitat to development, will affect our suite of individual- and population-level predictions. Ultimately, these simulations allowed us to assess how the carrying capacity of the landscape would respond to land use changes. The IBM-based approach allowed the effects of each aspect of land use change to be modelled synergistically, as well as independently. Finally, we used a sensitivity analysis to assess how parameter value uncertainty influenced our conclusions. Our work highlights that IBMs are useful tools to predict avian responses to environmental change and improve our understanding of the mechanisms which underpin such responses.

Kevin Wood is an early-career researcher with broad interests in how avian populations respond to environmental change. His research uses a mix of field ecology, statistical analyses, and simulation modelling to identify threats to waterbird populations and inform their conservation and management.

WEDS, 28 MARCH, 1020 h

Does warming along migration routes explain the advancement of spring arrival in long distance migrants?

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The climate change-related advancement of the onset of spring at the breeding grounds represents an adaptive challenge to long distance migrant that may need to adjust their arrival timing in order to synchronise breeding with the peak availability of food. A trend towards earlier arrival in recent years is evident across a range of species, raising the question as to whether the observed changes are driven by evolutionary adaptation or phenotypic plasticity and whether they may be sufficient to keep up with advancement of spring on the breeding grounds.

Open-access internet platforms such as the UK BirdTrack survey represent a new data source for estimating the arrival timing of a wide range of migrant species. Twenty first century survey approaches may therefore assist with addressing twenty first century questions in ornithology.

The dependence of median UK arrival dates for a range of migrants upon weather conditions along migration routes has been evaluated using BirdTrack. A significant correlation with local temperatures in particular is found for this UK data set, supporting the findings of earlier studies of arrival timings in Scandinavia which indicate that climate warming along the migration route

accelerates the migration process resulting in earlier arrival at the breeding grounds. A substantial element at least of the observed recent advancement in arrival dates would therefore appear to arise from phenotypic plasticity.

Further insights into the mechanisms influencing arrival date advancement can be gained from comparative studies of the comprehensive range of migrants covered by the available BirdTrack data.

Mark Eddowes is an independent researcher with a particular interest in long-distant migrant arrival phenology developed through volunteer involvement in ornithology. He has a Doctorate in Chemistry and published on a variety of topics in electrochemical kinetics before moving into technical consultancy.

WEDS, 28 MARCH, 1130 h

KEYNOTE

Patterns of alien species: future scenarios and consequences for birds

Tim M. Blackburn[1,2]*, Ellie E. Dyer[2] & Hanno Seebens[3]

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One of the primary ways that humans are causing global environmental change is by translocating a wide range of species to areas beyond their normal biogeographic distributions. Such species – here termed aliens – are now a feature of more or less every biological community worldwide. A proportion of alien species become invasive (invasive alien species, or IAS), meaning that they spread potentially widely across their new recipient area, causing negative impacts on the natural and/or socio-economic environments they encounter. These impacts provide a strong incentive to understand the process of invasion, for biosecurity and conservation biology.

Here, we explore the history of alien species, and what the past tells us about the likely future for such species, both in terms of patterns of alien species occurrence, and alien species impacts. We focus mainly on birds as a model taxon, both as aliens and as a group that has suffered from the impacts of aliens. We start by showing how the history of bird species introductions has been affected by human activities, and the consequences of this for current and future patterns of alien species richness. We show that invasions are continuing to accumulate at ever-greater rates, but that birds are somewhat anomalous in the occurrence of new alien species. We go on to consider

evidence for the impacts of birds as IAS, and IAS on birds, and what that may mean for the future of avian conservation biology.

Tim Blackburn is Professor of Invasion Biology at the Centre for Biodiversity & Environment Research, University College London. He is jointly employed by the Zoological Society of London, where he was until recently Director of their Institute of Zoology. His research interests concern large-scale patterns in the distribution and abundance of species, particularly focusing on the causes and consequences of alien invasions, using birds as a model taxon.

WEDS, 28 MARCH, 1200 h

Codispersal services by waterbirds: implications for expansion of alien species and redistribution of native species under climate change

Andy J. Green[1*], Ádám Lovas-Kiss[2], Victor Martín-Vélez[1], Marta I. Sánchez[1], David M. Wilkinson[3]

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Seed dispersal has been considered the most important ecosystem service provided by birds. However, the vast majority of research has focused on frugivores and scatter-hoarding corvids, wrongly implying that birds are not important vectors for plant species that lack a fleshy fruit or a large nut (thus overlooking the great majority of plant taxa). Ultimately, this research habit is likely to be explained by Darwin's legacy. Using new data from the UK and continental Europe, we describe the broad range of plants dispersed by migratory Anatidae, shorebirds and gulls, as well as the increasing variety of invertebrate taxa. This includes unique observations of dispersal of mosses, ferns, sponges, and a range of alien angiosperms by survival of passage through the avian gut. We illustrate the major implications of these findings for the spread of alien species, as well as the redistribution of native species in response to climate change and to changing patterns of bird migration. For example, many aliens assumed to be spread by human activity are readily spread by bird populations that concentrate in areas of low human density, and management of invasions is unlikely to be successful until this is recognized. Furthermore, migratory birds provide far greater maximum dispersal distances for seeds than other vectors such as wind or water, such that they are critical vectors if plants are to change their distributions in pace with climate change. We suggest this area of research provides both a major *opportunity* and *challenge* for ornithology. Avian codispersal services exemplify the benefits of conserving migratory bird populations in a changing world. A major challenge that remains is how to predict *which* taxa are dispersed effectively by migratory birds, since

the limits remain very unclear and traditional methods (e.g. based on seed morphology) are inadequate.

Andy Green is an ecologist focusing on waterbirds and wetlands. Since completing his DPhil on sexual selection at Oxford and researching into globally threatened wildfowl at WWT Slimbridge, he has spent over two decades based in the Doñana Biological Station researching mainly in Mediterranean systems.

WEDS, 28 MARCH, 1215 h

Prioritising wetland conservation by quantifying resistance and resilience to extinction among papyrus-endemic birds in East Africa

Lynda Donaldson[1]*, Jonathan Bennie[2], Robert J Wilson[3] & Ilya MD Maclean[1]

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Limited conservation resources and ambitious biodiversity targets necessitate effective and efficient conservation planning. Traditional site-based conservation approaches often focus on reducing the extinction risk of species at particular sites. However, with increasing levels of fragmentation from land use change and pressures from climate change and overexploitation, the surrounding landscape will play a role in ensuring persistence as a whole. Using metapopulation theory, we present a framework for quantifying the resistance and resilience of populations to extinction, depending on their likelihood of survival and probability of re-establishment following extinction events. We apply this framework for the conservation of a group of bird's endemic to papyrus (*Cyperus papyrus*) swamps in E and C Africa, which are highly threatened by large-scale habitat loss and degradation, yet currently receive very little protection. We use occupancy data collected from a network of swamps in SW Uganda to identify the locations which contribute to regional resistance and resilience for individual species, and determine the potential to invest in areas that are most important for all species combined. The results demonstrate that resilience to extinction is low across the landscape, causing concern for the persistence of particular species following localized extinction events. Despite varying degrees of resistance and resilience among species, several sites support populations of all species that are both highly resilient and resistant to extinction, highlighting where future efforts should be focused to halt further declines. Overall this work demonstrates the utility of the resistance-resilience framework for the conservation of multiple species occurring in human-dominated landscapes, where wise decisions surrounding the investment of limited conservation resources are paramount.

Lynda Donaldson recently completed her PhD on the conservation and ecology of African wetland birds. Broadly her research explored conservation planning in fragmented landscapes, with a focus on papyrus-endemic birds in Uganda. She is interested in identifying practical solutions for conservation that work for both biodiversity and rural livelihoods.

WEDS, 28 MARCH, 1230 h

Convergent evolution connects form to function in the world's birds

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The link between morphological form and ecological function is a central organizing principle in nature, but a lack of data has prevented a general understanding of how organismal traits are connected to ecological niches. Using comprehensive beak and body measurements for >96% bird species, we demonstrate that avian phenotypes map onto niches with remarkable fidelity, predicting variation in resource use and foraging strategy with over 70% accuracy. We also show that this fundamental association arises through the independent convergence of ecologically similar bird lineages toward the same regions of phenotypic space, particularly when their geographic ranges are isolated, presumably reducing competition. Our analyses suggest that ecological adaptation generates a universal structure to bird diversity, and offer a quantitative trait-based framework for understanding the evolution, assembly and functioning of bird communities worldwide.

Joe Tobias started out as a behavioural ecologist with a PhD on European Robins at Cambridge University, then worked for BirdLife International and other conservation NGOs, before returning to academia as a Lecturer in Evolutionary Ecology at the Edward Grey Institute, Oxford University. He is now a Senior Lecturer in Biodiversity at Imperial College London, where his research group studies avian macroecology and macroevolution, with a particular focus on understanding how complex ecosystems function and respond to environmental change.

WEDS, 28 MARCH, 1415 h

KEYNOTE

Habitats in a changing climate: population impacts and implications for conservation

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We expect key drivers of changes in bird populations over the next few decades to be changes in climate, increased global food demand, and the direction of environmental government policy. Changes in climate are expected to cause continuing shifts in bird distributions and result in an overall decline in the breeding populations of several species groups including seabirds and mountain birds. Low-lying coastal habitats are expected be under increasing pressure from sea level rise and erosion, leading to a reduction in the extent and quality of some current coastal waterbird hotspots. Escalating food demand is likely to drive further intensification in farming. The direct effects of climate change on farmland birds are likely to be small, compared to the effects of agricultural policy and practice. The effects on birds of future forest management are difficult to predict and depend both on future markets for forest products and on measures adopted to increase resilience to climate and tree diseases. Against a backdrop of changing climate and a less wildlife-friendly wider environment, it will be essential to ensure that protected areas increase in extent and continue to provide suitable conditions for conservation-dependent species. In some cases high levels of intervention management will be required to achieve this, though rewilding may benefit a small suite of species. The delivery of large-scale habitat restoration, through schemes designed to provide other public benefits, particularly climate regulation, flood defence and outdoor recreation, represents a major conservation opportunity.

Malcolm Ausden is Principal Ecologist at the RSPB, where he advises on habitat creation and the management of the RSPB's nature reserves, particularly wetlands and heathlands, and how best to respond to the effects of climate change. His current projects include leading on the ecological design of Wallasea Island Wild Coast, the largest coastal wetland ever created in the UK, and production of a natural capital account for the RSPB's nature reserves in England.

WEDS, 28 MARCH, 1445 h

Evidence for contrasting climate change impacts at different life history stages in the Mauritius kestrel

Joseph Taylor[1,2*], Ken Norris[2], Malcolm Nicoll[2], Emily Black[3], Pier Luigi Vidale[3], Carl Jones[4,5] & Vikash Tatayah[5]

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Projected climate change is expected to be accompanied by changes in the frequency and severity of extreme weather events, which may pose a greater risk to ecosystems than changes in average weather regimes. However, we still lack sufficient understanding of the long-term demographic impacts of extreme weather on animal populations, including island endemic species, which are expected to show particularly high vulnerability to climate change. The definition of extreme weather events in ecological research is a subject of ongoing discussion.

We extended previous research into weather impacts on the demography of the Mauritius kestrel (*Falco punctatus*), an endemic forest raptor whose extinction has been averted by targeted conservation work. It breeds in the austral spring, with many young fledging in the cyclone season. Previous research on a reintroduced population in eastern Mauritius found that rainfall negatively impacts breeding success, causes delays in egg-laying and negatively affects juvenile survival. In the present study, we placed emphasis on extreme weather events and used meteorological definitions, which can be directly related to climate research. Local weather station data indicate increases in overall and extreme rainfall in the study area.

Our analyses, using >20 years of data, confirm the findings of previous research regarding rainfall impacts on breeding success and phenology, and identify prolonged rain spells during the cyclone season as a factor in reduced juvenile survival. While delayed breeding is linked to increased rainfall, there is a stronger correlation between increasing average temperatures and earlier breeding. The overall trend towards earlier breeding could reduce the exposure of nests and fledglings to heavy and prolonged rainfall. This research illustrates the importance of studying multiple weather dimensions and life history stages when untangling climate change effects and projecting future impacts.

Joseph Taylor is a PhD candidate with particular interests in wildlife conservation and the impacts of extreme weather events. His wider interests include the interface between the needs of human society and biodiversity when building resilience to climate change.

WEDS, 28 MARCH, 1500 h

Implications of increasing hurricane intensity: sensitivity to catastrophic disturbance among bird guilds in a Mexican wetland

Matthew D.M. Ruiz*, José Luis Rangel-Salazar, Jorge L. León-Cortés & Paula L. Enríquez-Rocha

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A human-induced upturn in sea surface temperature is a probable cause of increasing hurricane intensity in the Pacific and North Atlantic over the last 40 years, with serious implications for future coastal ecosystem damage. Hurricanes in the Neotropics can change the composition of forest bird assemblages, particularly in plant-consumer guilds. Although mangroves are prone to hurricane impact, the trophic resources they supply to landbirds are mainly invertebrates, rather than fruit or seeds. Empirical observations can help establish whether plant-consumer, insectivore or aquatic bird guilds in mangroves undergo change after hurricane impact.

To identify bird guilds that are potentially sensitive to increasing disturbance intensity, we analysed the effect of category II Hurricane Carlotta on bird assemblages in mangrove and marsh habitat types of a coastal lagoon in Oaxaca, Mexico. We used 36 consecutive months of intensive point count data to expose patterns of inter-annual turnover in trophic guilds, to test for relationships between turnover and disturbance intensity, and to separate effects for resident and migratory species. We used two years of observations to evaluate changes in detection ratios.

Turnover among terrestrial insectivores was significantly high in the mangrove between years before and after Carlotta, but not between the two years prior to the disturbance. This pattern held in more heavily impacted red mangrove (*Rhizophora mangle*), but not in white mangrove (*Laguncularia racemosa*). When resident and migratory species were analysed separately, the effect was only apparent among residents. The proportion of observations between 25 m and 50 m count radii was lower after Carlotta, but this reflected an absolute increase in observations <25 m rather than decreased detectability at greater distances. The degree of change in terrestrial insectivores provided an indirect measure of hurricane impact across habitat types and resident species in red mangroves emerged as the most sensitive bird species group.

Matthew D.M. Ruiz has worked in tropical research and conservation during twelve years of residency in rural Mexico. His research focuses on bird assemblage structure and temporal dynamics across wetland habitats. He has on-going involvement in community-based bird monitoring and mangrove restoration in Mexico and has recently returned to England.

WEDS, 28 MARCH, 1515 h

Effects of climate change and land use intensity on laying dates and population growth rates of Black-tailed Godwits

Rosemarie Kentie[1],* Tim Coulson[1], Jos C.E.W. Hooijmeijer[2], Ruth A. Howison[2], A.H. Jelle Loonstra[2], Mo A. Verhoeven[2] & Theunis Piersma[2,3]

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In this era of global climate change and large scale human induced habitat degradation, species need to respond to change in order to avoid population declines or even extinction. In seasonal environments, increasing spring temperatures often leads to advanced timing of reproduction in many taxa. However, not all trophic levels advance at the same rate, which leads to ecological mismatches. Simultaneously, deteriorated habitats may influence timing of breeding due to social or habitat cues. We studied the effect of changing spring temperatures and habitats differing in quality on the laying date and population dynamics of black-tailed godwits, a grassland bird breeding in agricultural fields in North-West Europe. We parameterised Integral Projection Models (IPM) with long term data of godwits breeding on farmland of low, intermediate and high land use intensity, and simulated three temperature scenarios reflecting the period from 1900-1970, the period during data collection (2007-2016) and an invented, warmer, future scenario. Early breeding birds on low intensity land use produced most offspring, and laying date was negatively influenced by current spring temperature, while positively influenced by spring temperature in previous year. We found no relationship between adult survival and laying date, nor a relationship between the laying date of the parents and its offspring. We predicted that laying dates on low and intermediate land use would be similar, and higher on high land use, and advancing when spring temperature increases. Moreover, we found that growth rate was only positive in the past and recent spring temperature scenario on low intensity fields, and overlapping zero or negative for all the other scenario's. Our study shows that, even with pressures selecting for earlier breeding, deteriorating habitats may prevent advancing laying dates.

Rosemarie Kentie focusses on ecological and evolutionary processes that determine the dynamics of populations. She is particularly interested in how or if animal populations adapt to the ever greater changes of our natural environment. She is an International Newton Fellow working at the Department of Zoology, University of Oxford.

WEDS, 28 MARCH, 1530 h

Climate change impacts on seabird populations: latest evidence and future research priorities

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The UK holds internationally important populations of seabirds which have shown substantial declines in recent decades. These populations are legally protected, act as cost-effective indicators of marine environmental change and play an important role in recreation and culture. Climate change is considered to be one of the main causes of the recent declines. Effects of climate on seabird populations may be indirect via changes in food supply, or direct such as mortality from extreme weather events. Understanding the extent of these effects is critical since climate models predict an increase in mean temperature and in the frequency and severity of extreme weather events. Furthermore, the extent to which climate change interacts with other anthropogenic drivers such as fisheries, plastics and marine renewables may be of profound importance. Accordingly, seabirds face an uncertain future and may decline further in the coming decades. The Marine Climate Change Impacts Partnership (MCCIP) recently celebrated ten years of science to policy reporting. Here, we will provide a synthesis of evidence for climate change impacts on UK seabird populations that was undertaken for MCCIP's 10 year review. The talk will review the latest research on indirect and direct effects of climate on seabird populations and interactions with other drivers. A key finding of our review is that, given the large body of research underway on the ecology of seabirds, there is surprisingly limited focus on climate change effects. More encouragingly, studies are emerging that are forecasting future change, complementing retrospective analyses of past change. We will argue that a key research priority is to bridge the gap between current foci in seabird research on foraging and migration dynamics and climate change research needs. This can be achieved with more emphasis placed on longer-term temporal change and better connection between individual variation in behaviour and population dynamics.

Francis Daunt is a seabird biologist and his research links ecology, life history variation and population dynamics to understand the drivers of change in seabird populations, in particular climate change, fisheries and marine renewables. He coordinates CEH's long term seabird study on the Isle of May.

WEDS, 28 MARCH, 1630 h

KEYNOTE

The uplands – reflecting on change and challenging the challenges

Des Thompson
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Covering a third of Britain's land surface, the uplands are exceptional in their diversity and richness of landscapes and wildlife. Much of this has been shaped by human influence over millennia, and now we have reached a phase of unprecedented change, which some argue is characterised by a series of tipping points. For some the uplands offer a refuge for wildlife in retreat from more intensively managed areas. For others the uplands offer scope for transformational opportunities to restore woodland cover, meet renewable energy needs, change agricultural practices, and create new recreational and amenity space. For many, however, the uplands are still characterised as being distant – remote even - in public consciousness, though passionately debated over by those who live in or spend time in these areas. I reflect on the international importance of the uplands, the nature of changes, and then look ahead to what lies in wait for upland birds. I will draw on field and socio ecological studies, and applications of advanced technology, to consider and challenge the challenges ahead.

Des Thompson is the Principal Adviser on Science and Biodiversity in Scottish Natural Heritage and heavily involved in work supporting *Scotland's Biodiversity - a Route Map to 2020.* He has particular interests in field ecology, and his books cover a broad range of interests including birds of prey, shorebirds, alpine and upland habitats, and the Cairngorms and other mountain areas in Scotland. He chairs the Technical Advisory Group advising the UN Convention on Migratory Species (CMS) on the conservation of migratory birds of prey in Africa and Eurasia. As Chairman of the Field Studies Council (the UKs leading provider of outdoor environmental education) he enjoys encouraging students and others to pursue field studies. He is a Senior Research Fellow at Hatfield College, Durham University, and Fellow of the Chartered Institute of Ecology and Environmental Management, and of the Royal Society of Edinburgh.

WEDS, 28 MARCH, 1700 h

From radio tags to drop-off GPS-loggers: new tracking technologies can improve the efficacy of conservation programs for Nightjars

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To evaluate the accuracy of conservation programs for the European Nightjar (*Caprimulgus europaeus*) in Flanders (Belgium), we studied its habitat use between 2009 and 2017. Following new technological developments and personal technical adjustments, we changed from deploying radio tags (120; 2009-2014), over GPS-backpacks (60; 2014-2016) to VHF-GPS drop-offs (44; 2017). Each technology provided better insight into Nightjars' foraging behaviour, which can lead to an improvement of the efficacy of conservation programs.

Nightjars breed in semi-natural habitats, closely associated to sandy soils. In Flanders, breeding areas are mainly found in heathlands. Using radio telemetry, we found that these crepuscular insectivorous birds actually forage in extensively-grazed farmlands. In Flanders, Nightjars' breeding and foraging sites therefore occur in fragmented landscapes and are separated by unsuitable habitats. Protection of foraging areas is not included in Flemish conservation programs. Nevertheless, reduced connectivity between complementary resources, such as nesting sites and foraging areas, are known to influence birds' survival. Therefore, we assessed if landscape heterogeneity affects Nightjars' foraging behaviour. We studied 210 foraging tracks (GPS-backpacks) between breeding and foraging sites, compared food availability between both sites and measured a biomarker for oxidative stress in Nightjars. We found that Nightjars' foraging distance varies between study sites (1201±1059m vs. 3345±1921m) depending on habitat composition and configuration near breeding sites. Nightjars exploit a higher prey biomass in foraging sites, yet, birds that fly further spend more time foraging and show higher levels of oxidative stress. Landscape heterogeneity clearly influences foraging decisions of Nightjars. Improving the connectivity between essential resources seems elementary and will involve the redesign of landscape scenarios to optimize composition and configuration of complementary habitats.

Finally, to compensate for the annual loss of GPS-backpacks (50%), we now developed an efficient low-tech drop-off system to retrieve VHF-GPS loggers (11% loss). This allows us to track more birds in different areas, and support a continued improvement of conservation programs.

Ruben Evens is a biologist with a main research focus on foraging ecology and conservation. He is mainly interested in analysing foraging behaviour in order to describe the implications of landscape configuration on population processes in order to improve conservation management.

WEDS, 28 MARCH, 1715 h

How does native woodland restoration affect breeding bird communities?

David Douglas
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Habitat restoration will become an increasingly important conservation tool in the 21st Century. This includes re-creation of native woodland to reverse historic deforestation. In the UK, much reforestation comprises non-native conifer plantations. However, extensive restoration of native woodland is increasingly taking place, driven by national policies for woodland expansion and non-governmental initiatives (e.g. "rewilding"). This will result in one of the largest shifts in habitat type across the UK in modern times, with the replacement of large areas of open habitats with new native woodland.

Much woodland creation in the UK is expected to be targeted at land of low productivity value, for example unenclosed upland 'moorlands' that were formerly forested but have been largely treeless for centuries. Woodland restoration on and adjacent to moorland is expected to benefit woodland biodiversity, including species of high conservation importance. However, it may impact negatively on moorland biodiversity, which is itself of international conservation importance. Understanding the ecological effects of native woodland restoration in upland environments is of high policy importance.

This talk will present a study of the response of breeding bird communities to native woodland restoration in the Scottish uplands. In the study area, creation of native woodland has taken place since the late 1980s, mainly under government grants. The study area provides a chronosequence of woodland plots of differing age and varying proximity to unplanted moorland. This enables the testing of how bird communities change with woodland age and along a gradient from woodland to open ground.

Native woodland plots in the study area were found to support a range of bird species of high conservation concern. Breeding bird communities change with woodland age and between woodland and moorland-dominated areas. These results have implications for potential changes in bird communities more widely as woodland cover expands in the UK.

David Douglas works for the Scottish research section of RSPB Centre for Conservation Science. He leads RSPB's UK upland research, including work to inform the recovery of priority species such as curlew and whinchat, and wider land use issues including forestry, grazing, moorland burning and onshore wind farms.

WEDS, 28 MARCH, 1730 h

The World at our fingertips: how the Open Data Revolution is boosting opportunities for bird-habitat analyses

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Analyses of relationships between birds and their habitats have been limited by issues of scale and data availability. Whilst tracking and surveying allow bird locations, movements and activity to be mapped at high resolution across entire habitat patches, regions or continents, the collection of associated habitat data at the same scale and detail has hitherto been impossible. Due to issues of cost and practicality, habitat data has typically been limited to field-based sampling of small areas for extrapolation to the wider landscape, or to a coarse characterisation of broad habitat types. This mismatch between the scale and resolution of bird and habitat data has limited analyses of the associations between them.

Technological advances in remote sensing and mapping are rapidly improving the characterisation of habitats, with lidar and multi-spectral satellites offering models of landscape/vegetation structure and composition at scales that can surpass the bird data itself. From the three-dimensional precision modelling of entire forests or hedgerow networks, to the tracking of spring phenology across continents, and the monitoring of habitat change and degradation, bird habitat can be comprehensively mapped and summarised at the scale of the nest site, individual territory, population or global range. Additionally, climate, hydrological, geochemical and pollution data are now also widely available.

Whilst the collection and analysis of such high-quality data has often been prohibitively expensive, due to costs of hardware, software and specialist skills, the widespread adoption of Open Data policies by governments and institutes has led to a revolution in the availability of free data.

Furthermore, open-source software has provided the tools for relatively non-specialist users to access and analyse this information. Examples of data portals and case studies will illustrate how Open Data can revolutionise bird-habitat analyses, made possible by the increasing alignment of remote sensing, environmental modelling, and avian tracking and surveying.

Richard Broughton is an ecologist and GIS specialist, with particular interests in integrating field-based data with remote sensing of habitats, especially when applied to woodland and farmland birds.

THURS, 29 MARCH, 0900 h

KEYNOTE

The times they are a changing: What does the future the hold for seabirds?

Beth E. Scott
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The marine environment is changing rapidly due to effects of climate change and increasing anthropogenic activities in terms of new fishing practices & ecosystem-based policies, as well as very large-scale renewable energy extraction. What will this mean for our contrasting seabird species? To answer this question we need to look closely at how the pressures are effecting preferred marine foraging habitats and the availability/catchability of seabird's prey. We are just starting to understand which type of marine habitat seabirds prefer to forage in and with the aid of tags and accelerometers we are beginning to appreciate WHY species may prefer these habitats. This talk will cover the increased mechanistic understanding of how seabirds use different types of habitats and will show how this knowledge may help us to understand why our surface feeding seabirds are faring so much worse than those that can dive deeper for prey.

This talk will also explore how climate change is rapidly varying the biological and physical characteristics of these habitats with new fine-scaled coupled 3D bio-physical oceanographic information. Different habitat variables such as primary production and temperature are changing in quite different directions such that seabirds and their highly mobile prey may be reacting to climate changes quite differently. Future marine environments may have highly altered spatial distributions of prey availability and the decisions we are making today concerning spatial management and where we allow what types of anthropogenic activities to take place - need to take these changes into account.

Beth Scott has a multi-disciplinary background in marine ecology, oceanography and fisheries. Her approach has been to focus on the functional linkages between fine scale bio-physical oceanographic processes, flexible individual life history traits and population dynamics of a range of fish and seabird species through both empirical data collection and modelling approaches. Beth's current focus has been the spatial and temporal identification of critical marine habitats where mobile predator and prey species interact.

THURS, 29 MARCH, 0930 h

How to use science to inform decision-making; the case of birds and renewable energy development

Lucy J. Wright[1], Aly McCluskie[2], Alex Sansom[3], Saskia Wischnewski[1], Ellie Owen[2], Mark Bolton[1], Alison E. Beresford[4], Emma Teuten[5] & Rowena H. W. Langston

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Climate change is one of the biggest threats to biodiversity in the 21st century, and a key measure to minimise its magnitude is renewable energy development. However, such developments bring their own potential threats to birds. Careful siting and design of renewable energy projects is important to minimise their impacts, especially on populations already depleted by the damaging effects of climate change. A critical scientific challenge for ornithologists is to understand the impact of developments in the marine environment where it is difficult to monitor birds, particularly in poor weather and at night. We must work with the industry to determine how best to site and design renewable energy projects such that the impacts to birds, and other biodiversity, are minimised.

We present RSPB's current work using new technologies such as GPS and accelerometer tracking, complemented by more established ecological monitoring methods and expertise, to tackle some of these scientific challenges. We describe how we use our science, and that published by others, to influence decisions and policies regarding the deployment of offshore renewable energy in the coming decades. Specifically, we present ongoing work in collaboration with a wind farm developer, DONG Energy, to study how seabirds at one of the UK's most important colonies may change their behaviour around wind turbines, that will address questions about collision risk and avoidance behaviour, currently a critical evidence gap. We demonstrate how we use tracking data to identify

important areas for seabirds where development is more risky. We describe how we use science to challenge high-risk development proposals, to shape the design of offshore renewable energy schemes to minimise the risk to seabirds, to influence the methods used by developers and policymakers to assess impacts, and to advocate for renewable energy strategies that meet emissions targets whilst minimising the impact on biodiversity.

Lucy Wright is a Principal Conservation Scientist at the RSPB Centre for Conservation Science. Her team investigates the environmental impact of proposed developments, including renewable energy installations, and the effectiveness of protected area networks for species conservation. We provide scientific evidence to underpin casework, policy and advocacy on these issues.

THURS, 29 MARCH, 0945 h

Population and Individual responses to environmental variability

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In ecosystems the world over, animals rely on resources scattered over patchy, heterogeneous landscapes. Birds journey to exploit large-scale environmental features that persistently enhance prey availability, however the importance of fine scale environmental changes for behaviour and reproduction is less well understood. Do populations adapt to their proximal environment to reliably find food? Which is more important: the constant physical landscape or dynamic oceanographic features that change in time? Here, we pose these questions to a species occupying a wide range of environments around the UK to explore the mechanisms behind different foraging strategies that emerge between populations. By comparing the drivers of foraging behaviour and reproductive success of black-legged kittiwakes from 20 colonies governed by different oceanographic regimes, we will ask whether species are suited to an optimal environment or can adapt via behavioural plasticity. In light of rapid regime shifts, these results will develop our understanding of the ecology of top predators that perform key ecosystem roles and that we so often rely on as environmental indicators.

Alice Trevail is a third year PhD student, with a particular research interest in the link between the physical environment and individuals, as well as how we can use marine top predators as indicator species for conservation and management.

THURS, 29 MARCH, 1000 h

Environmental change and carry-over effects determine productivity and phenology at a European Shag *Phalacrocorax aristotelis* colony over half a century

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Environmental conditions are a key determinant of fitness in wild animals. Principal mechanisms include the bottom-up effects of climate on resource availability and direct effects of weather on behaviour and survival. In long-lived species, these effects may be immediate or have downstream consequences where conditions experienced in one season may also affect the condition, life-history decisions and thereby fitness of populations in subsequent seasons ("carry-over effects"). Populations will be affected by both immediate conditions and carry-over effects concurrently, yet few studies have quantified both simultaneously.

We utilise long-term demographic data spanning five decades (1965–2016) collected at a North Sea European Shag *Phalacrocorax aristotelis* (hereafter shag) colony, to quantify trends and test the immediate and delayed determinants of reproductive performance. Productivity increased over the study, from 2.00 chicks nest^{-1} in 1965 to 2.28 chicks nest^{-1} in 2016. Concurrently, phenology has advanced, with shags now breeding ~26 days earlier than at the start of the study. Productivity was higher following poor winter weather, as indicated by stronger onshore wind. Furthermore, reproductive performance was also driven by mechanisms operating on breeding phenology, which is strongly negatively related to breeding success (i.e. early individuals are more successful). Phenology was determined by both lagged and current Sea Surface temperature, with individuals breeding later following higher SST in the previous year, but earlier when the SST was higher prior to breeding. Breeding was also earlier following high productivity in the previous year.

Crucially, this analysis demonstrates that trends in reproductive success observed within this population were largely determined by carry-over effects from past reproductive effort and environmental conditions, mediated via phenology. Our results indicate a complex suite of mechanisms that may have important demographic implications for this species in response to predicted future changes in climatic mean conations and weather variability.

Rich Howells is an ecologist, currently undertaking a PhD on European Shags *Phalacrocorax aristotelis* breeding on the Isle of May, Scotland, using dataset collected over half a century. He is particularly

interested in the role of mean environmental conditions and variability in determining key demographic parameters, including diet and reproduction.

THURS, 29 MARCH, 1015 h

Marine birds in trouble

Ian Mitchell[1*], Aonghais Cook[2], Graham French[1], Jane Hawkridge[1], Volker Dierschke[3], David Fleet[4], Tycho Anker-Nilssen[5], Kees Kofijberg[6], Frederik Haas[7] & Eric Stienen[8]

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'Marine Birds in trouble' is one of the conclusions of the latest assessment of the northeast Atlantic ecosystem, which was undertaken by the OSPAR Commission in 2017 (https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017). The aim of OSPAR's 'Intermediate Assessment 2017' (IA2017) was to describe the human pressures on the northeast Atlantic, their effects and the implications for biodiversity. The IA 2017 included the development and assessment of 41 indicators covering the status of marine habitats and species and the magnitude of pressures, such as contaminants, litter, underwater noise, non-indigenous species and fisheries.

This paper focuses on the assessment of marine bird abundance and marine bird breeding success/failure. The assessments of these two indicators is the culmination of 10 years of development by experts from countries bordering the northeast Atlantic. The assessments used time series data (1991-2015) on counts and breeding success of seabirds, waders and waterfowl collected (mostly from land) within the OSPAR Regions of the Celtic Seas and the Greater North Sea and the Norwegian Part of the Arctic Region.

The assessment concluded that in the Norwegian Arctic, the Greater North Sea and the Celtic Seas, there has been a considerable (>20%) drop in abundance compared to the levels observed 25 years ago, for more than a quarter of the marine bird species assessed. Species that use intertidal and inshore areas of the Greater North Sea during migration or over wintering were the exception, and have been present in healthy numbers since the early 1990s. Frequent and widespread breeding

failure has been observed for many species, especially those feeding on small fish in the surface waters of the Greater North Sea and Celtic Seas. Prey availability is likely to be driven by ecosystem-specific changes, possibly impacted by commercial fisheries and climate change.

Ian Mitchell has worked on the monitoring and assessment of seabirds for 20 years. He now supports the development and implementation of the Marine Strategy Framework Directive and the OSPAR Convention, with particular emphasis on marine biodiversity assessments. He is co-chair of the ICES/OSPAR/HELCOM Joint Working Group in Marine Birds (JWGBird).

THURS, 29 MARCH, 1115 h

KEYNOTE

The Internet of Wings: Current advances in technology and future possibilities, and impacts on science, conservation and citizen science

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Nikolaas Tinbergen postulated half a century ago that in order to understand traits or behaviors of organisms, we need to analyze them at four levels: phylogeny, mechanism, ontogeny and survival. Whereas in birds we know much about phylogeny, we know little about mechanisms in the wild, much less about ontogeny and even less about where, when and why individuals die. New bio-logging technologies are on the horizon that now allow us to fill this essential knowledge gap in birds that often migrate across hemispheres. As avian biologists will start to understand the influence of ontogeny on life history decisions and survival of individuals, they will again set standards for the rest of animal ecology. At the same time, we will finally know how best to conserve our feathered friends. Citizen scientists will become ever more essential in ornithology as they can attach electronic bands instead of just numbered rings, and will be able to digitally follow their individual birds throughout space and time. Because bird amateurs then know the locations and behaviors of tagged birds, they become ´earth guardians´ by personally observing and guarding their individual birds wherever they are. While doing so, they learn about the birds´ collective behavior and habitat imprinting, as well as link remote sensing earth observation data to understand individual decision making in response to the environment. Linking together this knowledge in global data bases, we establish the Internet of Wings. A golden era for ornithology is on the horizon.

Martin Wikelski Director, Max-Planck Institute for Ornithology and Professor, University of Konstanz.

THURS, 29 MARCH, 1145 h

Balancing Afrotropical biodiversity and agriculture through food web models and DNA metabarcoding

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Anthropocentric destruction of natural ecosystems, such as tropical rainforests, has created an urgent need to balance agricultural production with biodiversity. If we are to maintain functioning ecosystems in this rapidly changing world, we must prioritize both species that maximize ecosystem support for crops ("ecosystem service species") and those that maximize biodiversity ("keystone species"). Food web models offer an ideal platform for exploring the sensitivity of ecosystems to management; however, two key components are missing. First, we need a method for rapidly quantifying relationships among organisms in the food web; second, we must train food web models to behave like the real systems. To overcome the first issue, we will characterize species interactions in cacao plantations in Cameroon and Equatorial Guinea with novel diet metabarcoding techniques, in which prey of hundreds of birds as well as the plant taxa consumed by prey can be simultaneously identified. Secondly, we will construct novel Bayesian food web models which will dynamically adapt connections among species to changes in abundance. With species identifications from metabarcoding, we will build food web models of African shade cacao plantations to address several objectives, including: 1) identifying the species that are most influential in encouraging crop yields and increasing biodiversity and, 2) understanding how landscape context (e.g., distance from cacao plantation to primary forest) affects food web dynamics. Our cuttingedge approach will provide an ecosystemlevel understanding of the relationship between biodiversity and agricultural production, allowing sustainable management of crops alongside a highly diverse ecological community.

Luke Powell has worked in tropical rainforests across the Neotropics and Africa, primarily to understand the vulnerability of insectivorous birds to anthropogenic change. Dr. Powell also co-founded and now directs Biodiversity Initiative, an NGO dedicated to promoting biodiversity conservation, especially related to birds in Africa and beyond.

THURS, 29 MARCH, 1200 h

Infrared thermal imaging to assess physiological state in free-living birds

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Understanding physiological processes is key to answering the questions of why organisms behave in the way they do, and how they interact with each other, and their environment. But, gathering physiological data from free-living organisms is challenging. Assessment of physiological state in the natural environment generally requires subjects to be trapped and handled, so blood/tissues can be sampled, or for measurement devices to be attached/implanted. Such methods limit research to species and individuals that can be caught, restricting the generalisability of findings. Also, natural behaviours are interrupted, and subsequent physiology, behaviour and performance can be affected.

One alternative strategy is to examine traits that can be measured without invasive sampling, which relate to underlying physiological processes in a predictable way. Body temperature is particularly promising in this context, being linked with multiple physiological functions including metabolism, and stress-state. Nonetheless, relationships between physiological state and body temperature remain poorly understood in free-living species, principally as measuring body temperature also used to require trapping and handling. Recently, however, low-cost, highly-portable thermal imaging cameras have opened up new opportunities to remotely measure body surface temperature (T_s) multiple times per-second.

Here, we investigated the applicability of T_s, measured using thermal imaging, as an indicator of physiological state in free-living organisms. Specifically, we compared T_s with plasma glucocorticoids and body condition, and examined the effect of acute stress on T_s, in wild blue tits (*Cyanistes caeruelus*). In undisturbed birds, baseline T_s was related to body condition and baseline glucocorticoids. T_s also exhibited a complex response to acute stress, with dynamics linked to physiological state independently of environmental conditions – an especially useful quality for traits to be measured in uncontrolled natural environments. Combined, these results suggest thermal imaging could provide a novel, non-invasive method for assessing both shorter and longer term physiological state in free-living organisms.

Paul Jerem is a recent PhD graduate interested in using physiology to address questions of ecological function. His PhD research explored the possibility of using thermal imaging to infer

physiological state non-invasively in wild animals, with a particular focus on stress-related traits and applications in conservation biology.

THURS, 29 MARCH, 1215 h

Application of Morphic-Google Images web tool for ornithological studies

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Information on the spatial distribution of phenotypic traits can be important for evolutionary and ecological studies. However, traditional approaches, such as fieldwork, can be time-consuming and expensive. Information technologies, such as Internet search engines, could facilitate the collection of these data.

We investigated the use of Google Images to extract data on geographical variation in phenotypic traits visible from photographs. We compared the distribution of visual traits obtained from Google Images with four previous studies. We found very good agreement between fieldwork data and Google Images data across all studies. Our results suggest that this method can work well for visible traits of common and widespread species and may have many other uses. To facilitate the data capture of this method we developed a free-to-use web application (Morphic).

Using the Morphic web app we use this approach to extract spatial data in a range of novel systems, and present the findings from two of these studies. Firstly, we use this approach to explore the suspected clinal variation in the morph distribution of Swainson's Hawks across their North American breeding distribution, and whether these patterns are correlated with environmental variables. Secondly, we investigate the diet across Africa of the declining Martial Eagle, comparing prey items among regions and between adult and sub-adults.
Our results suggest that the Google Images method is cost-effective, rapid and can be used with some confidence when investigating patterns of geographical variation, as well as a range of other applications. The opportunities that this approach offers to tackle ecological and evolutionary questions in ornithology are only just being explored, and we provide suggestions for other avenues of research that might be explored using this approach.

Arjun Amar is an avian ecologist, with a main focus on raptor ecology and conservation. He has worked on issue related to human-wildlife conflict, drivers of population declines and more recently on colour polymorphism in birds. Arjun is currently a Senior Lecturer at the FitzPatrick Institute of African Ornithology at the University of Cape Town, and was previously a Senior Conservation Biologist with the RSPB.

THURS, 29 MARCH, 1230 h

Can drones count gulls?

Matt J. Wood[1*], **Graham Rush**[1] **& Lucy E. Clarke**[1]

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Population monitoring demands accurate estimates of breeding population size and vital rates, enabling realistic and useful assessments of population dynamics. Counts of colony-nesting seabirds are relatively simple for open- or cliff-nesters, but some colonies can be obscured from ground observers due to inaccessible terrain or vegetation growth.

The capability and affordability of new technologies are advancing rapidly, with great potential to contribute to ornithology. Unmanned Aerial Vehicles (UAVs or 'drones') literally offer a bird's-eye view of seabird colonies using high resolution automated image capture, deployed to great effect in shore-nesting seabirds. Key to unlocking the potential of this technology is automated image analysis; to combine imagery of the colony into a usable GIS framework and to automate the counting of seabirds.

We explored the practicalities and utility of using a UAV to count breeding Lesser Black-Backed Gulls *Larus fuscus* in a colony where vegetation frequently obscures the view of observers counting gulls on the ground (Skokholm Island, Wales), focussing on the following objectives:

1. Can a UAV be flown at an optimum height, where imagery is sufficient for useful counts to be made without undue disturbance to breeding gulls?
2. Can semi-automated image processing be used to count gulls in the breeding colony?

By combining the skills of pilot and ornithologist, it was possible to survey breeding gull colonies using a UAV flown at an altitude of just 15 metres without undue disturbance, and with less disturbance than walk-through nest counts. Semi-automated processing based on supervised image classification was successful, yielding counts of gulls in the colony that were highly correlated with counts made manually from UAV imagery. Initial work shows promise for the automatic counting of the two other gull species present on Skokholm: Herring Gulls *Larus argentatus* and Great Black-Backed Gulls *Larus marinus*.

Matt Wood is a seabird biologist whose research focusses on advancements in population monitoring (UAVs, playback and thermal imaging), disease ecology and the effects of climatic variation. He manages part of JNCC's Seabird Monitoring Programme on Skomer Island, monitoring six species of seabird including shearwaters, gulls and auks.

THURS, 29 MARCH, 1415 h

#TheTweetingBird: its rise, relevance and impact in #ornithology

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Science communication is as fast moving as science itself, and in recent years, social media have come to the fore as important tools used for communicating science at the peer-to-peer and wider interested public levels. Within ornithology, Twitter is clearly the dominant platform with thousands of active users reaching a daily audience of over 500,000 people.

The rapid growth of online tools to communicate science raises the important question of whether online attention is associated with citations in the scholarly literature. The Altmetric Attention Score (AAS) quantifies the attention received by a scientific publication on various online platforms including news media, blogs and social media. It has been advanced as a rapid way of gauging the impact of a piece of research, both in terms of potential future scholarly citations and wider online engagement.

Here, we explore variation in the AAS of 2,677 research articles published in 10 ornithological journals between 2012 and 2016, analyse the contribution of the main scoring sources for AAS within ornithology publications and track the rise of the average AAS score within these publications. For a subset of articles published in 2014 we also investigated whether the AAS influenced the citation rate of these articles.

With the increasing take-up of social media amongst scientists, and in particularly the well-established and maturing online ornithology community, social media are set to play an increasing role in the communication of science and contribution to the citation of published research.

Steve Dudley is the BOU's Chief Operations Officer with overall responsibility for running and delivering most BOU activities including all social media and communications.

THURS, 29 MARCH, 1430 h

Predicting the response of British bird populations to future scenarios of land-use and food production

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Globally, agriculture presents the greatest source of threat to biodiversity, and recent empirical evidence from many parts of the world suggests that most species would fare least badly if food demand was met through high-yield production linked to the sparing of non-farmed habitats. However, in Britain our long history of glaciation and land clearance has potentially filtered out the species most sensitive to agriculture. In addition, many species of conservation concern are associated with 'wildlife-friendly' farmland, are threatened by the intensification of agricultural production, and so may be favoured by a 'land sharing' strategy. There is thus an urgent need – particularly pressing given reduced public spending and Brexit – to evaluate the trade-offs between food production, nature conservation and other ecosystem services in Britain.

For two regions of lowland England – The Fens and Salisbury Plain – we quantify the relationship between agricultural production (energy, protein and profit) and population densities of all assessable bird species. As in previous studies from other parts of the world, our results suggest that many species would do best under land sparing, though this is the worst strategy for some priority species. We use these relationships to evaluate various spatially explicit land-use scenarios – including sparing, sharing, intermediate and mixed approaches – in which total food production is maintained whilst varying the yield of farmed land and the area and configuration of non-farmed land. Our scenarios incorporate projected changes in other land-based services including, (1) climate-change-driven increases in flood water storage requirements, (2) wastage of fen peat soils, (3) housing needs and (4) military training requirements. Scenarios are then assessed in terms of implications for birds, human recreation, carbon storage, and future agricultural potential.

Tom Finch is interested in population ecology, land-use and conservation. His research generally focuses on birds, especially long-distance migrants and those inhabiting agricultural landscapes. He currently works for the RSPB and the Conservation Science Group in the University of Cambridge's Department of Zoology.

THURS, 29 MARCH, 1445 h

What role for agri-environment in 21st Century land bird conservation?

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Recovery of depleted land bird populations across large geographic areas is an ambitious but commonly-held aspiration of Governments and conservation NGOs. Agri-environment schemes (AES) provide a potential policy mechanism to meet such objectives but the achievability of such aims have rarely been tested. Given the ongoing costs of AES, and their uncertain future in a post-Brexit UK, it is important to understand and quantify the benefits that AES may deliver for wildlife, and to set realistic objectives for future schemes.

Drawing on 159 published studies from across temperate Europe, we review the evidence and circumstances under which AES interventions enhance the abundance or diversity of farmland plants, arthropods and birds. Success rates for birds were higher where AES measures provided specific ecological requirements (such as foraging or nesting habitat) and lower for simpler measures (such as field boundary and grassland management), for ground-nesting species and for grassland habitats. We report the findings of recent 10-year farm-scale multi-region evaluation of a generic higher level AES aimed at farmland birds in England but involving only modest levels of advisory support for landowners. Generic AES management packages substantially increased the abundance of a range of priority species and the suite of species comprising the Farmland Bird Indicator (FBI). We use these empirical findings to predict the amount of higher level AES that might be required to halt and reverse ongoing declines of farmland birds at the landscape scale. Such predictions will inform the development of realistic objectives for future interventions that aim to recover depleted land bird populations. Generic higher level AES may struggle to deliver the specialist ecological requirements of some of the more rapidly declining species, and in these cases more bespoke and carefully targeted packages will be required.

Will Peach is an ecologist based at the RSPB with long-standing interests in the causes of bird declines, and the design and delivery of conservation action. He is currently involved in research and conservation of a range of UK land birds mainly in lowland agricultural landscapes.

THURS, 29 MARCH, 1500 h

KEYNOTE

Changes in International Conservation issues

Juliet Vickery[1,4], **Stuart H.M. Butchart**[2,4], **Paul Donald**[2,4] **& James W. Pearce-Higgins**[3,4],

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An analysis of threats to the world's birds, based on data from BirdLife International's assessments for the IUCN Red List of Threatened Species, indicates that the most important threats to birds worldwide are agriculture (impacting over 80% of threatened species), logging (>50%), invasive species (>50%) and hunting/trapping (>35%). Climate change is a growing threat, but its impact on future population declines remains unquantified or uncertain for most species. In this talk we consider, first, how the nature and extent of the most important threats are likely to change in the next few decades under rapid environmental degradation and increasing human pressure on ecosystems. Second, we consider how this will require new scientific methods and approaches to provide the evidence needed to support decisions about how to maintain and restore global bird populations and their habitats. We do so in the context of change in four broad areas: disrupted earth systems including climate change and chemical cycles, social changes including rising consumption in developing countries and loss of connection to nature as the world urbanises; technology such as use of drones, tracking devices, earth observation data and novel methods for tackling invasives, and political change such as global mobilization around multilateral environmental agreements, post-2020 biodiversity targets and changes in global governance.

Juliet Vickery is head of international research at the RSPB Centre for Conservation Science, following a university research career at the universities of Oxford, Edinburgh and East Anglia, and at Scottish Natural Heritahe and the British Trust for Ornithology. She is an honorary research fellow at the University of Cambridge, BOU Vice President, Chair of the Policy Committee of the BES and on the expert advisory panel for the Darwin Initiative and the Cambridge Student Conference on Conservation Science.

POSTER

Modelling how to mitigate bird population declines in the UK through landscape-scale environmental management

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Biodiversity is declining on a global scale despite efforts to the contrary, and many UK birds have declined since the 1960s, particularly on farmland. Birds are effective indicators of ecosystem health, occurring in almost every habitat on Earth. Therefore, habitat diversity affects avian diversity attesting that birds are a vital resource to conservationists. Not only are the birds influenced directly by their immediate habitat, they are also indirectly affected by the surrounding landscape, indicating the need for local and landscape-level studies and management. This study takes a multi-scale approach to examine the consequences of habitat and landscape changes on bird populations in two contrasting and mixed land-use sites, the New Forest in Hampshire and predominantly arable farmland in Cambridgeshire. The New Forest is a National Park comprising a mixed woodland and heathland landscape. The woodlands are a mix of broadleaved Beech and Oak, interspersed with conifer plantations and stretches of heathland with encroaching scrub. Cambridgeshire, by contrast, is an agricultural landscape of mainly arable farmland with mostly deciduous woodland patches and hedgerows. Recently acquired, high resolution airborne remote sensing datasets (LiDAR) will be used to develop metrics that quantify structure, composition and condition of the two study landscapes. Bird community composition and diversity will be assessed in relation to remotely sensed metrics to determine the effects of landscape characteristics on bird community dynamics. At the landscape scale, bird distribution and abundance will be assessed in relation to landscape structure and composition, testing scenarios of how changes in land-use would affect bird population persistence. The overall aim of this study is to provide realistic measures to develop sustainable landscapes in order to conserve avian diversity.

Ailidh Barnes is in her final year of her PhD studying bird communities in various habitats in two contrasting landscapes. Her aim is to utilise habitat structure and composition in spatial modelling to evaluate habitats and provide sustainable management strategies in order to conserve bird species communities.

POSTER

Frontiers in invasive species distribution modelling: incorporating human-associations to improve risks predictions

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Biological invasions represent a major component of global change through their impacts on biodiversity, ecosystems and societies. Awareness of these impacts and the critical importance of evidence-based decision making have led to a persistent effort to understand the factors driving invasion success so as to be able to predict invasion outcomes. To this end, a range of modelling tools has been developed. Among them, species distribution models (SDMs) -phenomenological models that statistically relate observed species occurrences to environmental variables- play a critical role in invasion risk assessments. These models rely on ecological niche theory, which predicts that for recent events such as biological invasions, conservatism of the climatic niche is expected. However, recent studies showed that this approach could be hampered by apparent niche shifts in invasive ranges. Mismatches between native and invasive distributions derived from SDMs are often interpreted as species adaptations in response to selection pressures in novel environments. However, methodological drawbacks of previous approaches fuel doubts about the biological meaning of these findings. Among them, the heavy reliance of SDMs on macroclimatic variables might fail to account for other relevant factors, thus leading to poor predictions. In this study, we use an interdisciplinary approach combining occurrence, environmental and phylogenetic data to assess whether association with human-modified habitats in the native range, a species trait strongly associated with invasion success, might modify the distributional limits set by climate in current avian invasions and whether the role of human-associations in shaping species distributions in native ranges varies across the phylogeny. Our analyses are based on 971 bird species that have been introduced into the wild worldwide.

Laura Cardador is a postdoctoral researcher with a main research focus on macroecology and conservation. She is particularly interested in the ecological factors affecting species distributions and the application of modelling tools to guide relevant conservation and management decision making. Currently she is mostly focusing on biological invasions.

POSTER

Camilo Carneiro[1,2*], Tómas G. Gunnarsson[2] & José A. Alves[1,2]

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Wader species breeding at high latitudes in the northern hemisphere typically winter in wetland areas spread along continental coasts in temperate and tropical regions, spanning large latitudinal ranges. Given the large scale variation in local weather, quality and quantity of food resources and distance to the breeding area, the costs and benefits of wintering at a given site are likely to differ. In addition, the conditions experienced during winter will not only affect present individual state but can also affect subsequent stages of the annual cycle, in particular spring migration. Therefore, depending on the winter site and migratory strategy undertaken, individuals will require different amounts of energy to survive throughout the season and fuel the subsequent spring migration. The Icelandic Whimbrel (*Numenius phaeopus islandicus*) breeds mostly in Iceland and winters from Iberia to Benin. Their migratory strategies have recently been identified, with individuals undertaking one of two strategies during spring migration: a direct flight to Iceland or two flights with one stopover (usually in Ireland or Britain). In order to assess the costs and benefits Whimbrels experience during winter and their effect on spring migration, we (1) present the energetic balance experienced at three distinct wintering sites – Tagus estuary (Portugal, 39°N), Banc d'Arguin (Mauritania, 20°N) and Bijagós Archipelago (Guinea-Bissau, 11°N) – and (2) model spring migration costs for each migratory strategy.

Camilo Carneiro is a PhD student at the Universities of Aveiro and Iceland exploring the implications of long distance migratory strategies and variation of wintering habitat use on individual fitness. He investigates these links on Icelandic Whimbrels, developing fieldwork in Iceland and West Africa and using several individual tracking techniques (colour-rings, stable isotopes and geolocators).

POSTER

Physiological and parasitological effects of stress on Rufous-collared Sparrow *Zonotrochia capensis* on an urban-rural matrix in the high tropical Andes

Izan Chalen[1,3] , Diego F. Cisneros-Heredia[1,2] & María de Lourdes Torres[3]

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Urbanisation has dramatically changed landscapes, representing a novel challenge to many species whose habitats have been affected by this process. Some species appear to adapt better than others to urban environments. However, In some cases, even when population data shows good levels of adaptation, physiological data shows oppose patterns and species are under greater level of stress than in natural habitats. Stress includes several factors that can provide information about how species are adapting to novel environments, providing very informative data that allows researchers to make predictions about evolution, population ecology, and long-term conservation. In this study, we analysed cortisone levels and parasite prevalence of four populations of Rufous-collared Sparrow *Zonotrichia capensis* in the urban-suburban-rural matrix, including small gardens embedded in the urban matrix, medium-sized green sppaces in the suburban matrix, large parks in suburban areas, and natural areas surrounded by agricultural habitats. Urban areas were established over 30 years ago, while urbanisation growth has increased in the semiurban areas over the last 20 year. *Zonotrichia capensis* is a common bird in the Neotropics. Our results suggest that this species is well adapted to urban contexts, however individuals present some differences over their rural counterparts. Due to the possibility of zoonosis, parasitic data may be a concern regarding public health and urban planning.

Izan Chalen is student of Biology at Universidad San Francisco de Quito USFQ, Ecuador, with major interests in physiology and molecular biology.
Diego F. Cisneros-Heredia is full-time professor and researcher, director of Laboratory of Terrestrial Zoology, Universidad San Francisco de Quito USFQ, Ecuador.
María de Lourdes Torres, molecular biologist specialized in biotechnology and molecular ecology, full-time professor and researcher, Associate Dean of Biological Sciences, Universidad San Francisco de Quito USFQ, Ecuador

POSTER

Intake rates of wintering shorebirds along the East-Atlantic Flyway – are northern winterers always on top?

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Throughout winter birds must find enough resources to fulfil their energetic requirements. For migratory birds, selecting a wintering location is extremely important as conditions experienced in winter can have both immediate and future consequences, through carry-over effects.

Many migratory shorebirds winter along the costal fringes of continental land-masses thus occupying wide latitudinal ranges which can vary greatly in environmental conditions, e.g. habitats, prey availability and climate. Local conditions may be traded-off with other factors such as migration distance and for shorebirds wintering in the northern hemisphere fuelling rates in spring are known to decrease with latitude. However, flyway wide variation in winter feeding rates remains largely unexplored, potentially due to the logistic challenges of covering such large ranges and in sampling specific areas of difficult access. Moreover, while some populations are stable or increasing in some areas of the winter range (e.g. Europe), their conspecifics wintering further south (e.g. West Africa) are currently declining.

In order to understand the potential trade-offs experienced by shorebirds wintering along the East-Atlantic Flyway we collate intake rate data of several species and explore the drivers of such variation across sites. In addition, we quantify intake rates at the southernmost major wintering site on this flyway, the Bijagós archipelago in Guinea-Bissau, a mostly unstudied site that harbours large numbers of shorebirds in winter, and compare those to intake rates in more northerly sites.

Understanding shorebird winter feeding ecology and intake rate variation throughout the flyway will help assessing the costs and benefits associated with their winter distributions and contribute towards unravelling potential causes of varying population trends between different wintering areas.

Ana Coelho is a conservation ecologist interested in understanding how human-induced global changes affect biodiversity. Her master's degree explored how anthropogenic land-use changes affect the service of avian seed dispersal in a tropical island, and her current PhD focuses on understanding how migratory shorebird populations can be affected by environmental changes in the tropics, particularly in the Bijagós archipelago.

POSTER

Supporting the atlas: using the data behind bird atlas projects to produce estimates of habitat specific densities

Matthew Geary & Achaz von Hardenberg
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In order to make accurate inferences about species density and distributions, detailed survey data is required, in particular because, for most species, detection probability is likely to be imperfect. However, this kind of data is rarely available for most species due to resource constraints which limit spatial coverage or data quality. Citizen-science surveys, on the other hand, have the potential to produces large volumes of data which however is usually not very information-rich. Bird atlases are typically produced combining data from different sources which can span this spectrum of data. Using recently developed statistical approaches to integrate estimates from multiple data sources we can exploit the different kinds of data used to build bird atlases to provide insights into population density and species-habitat relationships.
We use data provided by the North Wales Breeding Bird Atlas 2008-2012 which consists of at least two visits to tetrads to record species presence, data from breeding bird surveys and incidental records from recorders. We first used n-mixture models to predict density for a sample of the data for which repeated observations and count data in the same sites were available for a variety of bird species, using habitat covariates extracted from land cover maps and observation-specific coavariates to inform detectability. We then use the coefficients and detectability estimates from these models as priors to inform models predicting habitat-specific densities and correcting for spatial bias from the rest of the dataset for which presence only data was available.

We discuss how more accurate habitat-specific density estimates can be obtained from this integrated approach maximising the use of the available data and how it can be used to inform conservation measures at a regional scale, inform future surveys and provide further value to the extensive survey effort undertaken by volunteers to complete the atlas.

Matthew Geary is a Senior Lecturer in Conservation Biology at the University of Chester. He is a conservation ecologist with a particular focus on birds and uses ecological models and statistical analyses to investigate population dynamics and distributions to produce recommendations for species conservation.

POSTER

The measurable cost of parasitism to reproductive success

Olivia Hicks[1], Sarah Burthe[2], Francis Daunt[2], Adam Butler[3], Mark Newell[2], Motohiro Ito[4], Katsufumi Sato[4] & Jonathan Green[1]

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Parasites are known to exert strong evolutionary and ecological forces on populations. However, despite parasites being ubiquitous these effects are rarely included in population models or considered in conservation. With parasite ranges extending due to changing climate it is timely and important to quantify the impact of parasitism on populations. Cormorants and shags are known to suffer from infections of intestinal parasites and we now have evidence showing foraging behaviours increase in energetic cost and decrease in duration with increased endo-parasite load. Although this effect is sub-lethal, it is logical to expect that during breeding these energetic effects of parasitism will be a constraint on adult provisioning ability. There is some evidence to suggest this may express itself in a reduction in reproductive output due to reduced ability to provision chicks, but this has yet to be explicitly tested.

Using a population of European shags, we were able to quantify endo-parasite load and breeding success over seven years. We show that endo-parasite load is negatively related to fledgling success in adult shags. While this effect is only seen in females, it is females that invest more in provisioning effort and reproductive output. Endo-parasite load was also found to be highly repeatable across years in females, strongly suggesting that an accumulated effect of parasitism may influence Lifetime Reproductive Success in this long lived species. In this study we provide evidence of the fitness consequences of parasitism to a free-living population of birds as well as the mechanism by which it operates. This mechanistic approach is likely to be important for better understanding future avian population trajectories in changing climates.

Olivia Hicks is a PhD student at the University of Liverpool. She is interested in using energetics as a tool to understand drivers of individual differences in reproductive success.

POSTER

Impacts of grazing on mountain bird populations: A meta-analysis

Susanne Jähnig, Antonio Rolando & Dan Chamberlain
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High altitude biodiversity is threatened by climate change and changes in land management. In the European Alps, both climate-induced upward shifts in the treeline and abandonment of pastoral practices have already resulted in the loss of high altitude open habitats (shrub-grassland mosaics and alpine meadows) in many areas. Grazing could be used as a conservation tool to maintain open habitats, but grazing management targeted in the wrong areas, or applied at intensive levels, could also be detrimental to biodiversity. In order to inform management strategies, we undertook a meta-analysis on the effects of grazing on mountain birds. Standardized effect sizes were calculated from studies carried out within objectively-defined mountain regions. There was no overall consistent effect of grazing. However, when species were defined according to their main nesting habitat (forest, forest-shrub ecotone, grassland), there were significant differences. Forest birds responded negatively to grazing, but ecotone nesting species were positively affected. There was no consistent response for grassland birds. This suggests that grazing could be a useful tool to maintain open habitats for shrub-nesting species around the treeline. Many of these species nest in shrubs that are unpalatable to livestock (e.g. rhododendron and juniper), hence grazing may maintain open grassy areas which are beneficial foraging habitats, whilst minimising damage to key shrub species, thus maintaining a habitat mosaic. Grazing could therefore be a key tool in preventing forest encroachment in the forest-shrub ecotone, which is typically the most biodiverse habitat within the mountain environment.

Susanne Jähnig is currently enrolled as a PhD student at the University of Turin, Italy. In her PhD she focuses on the impacts of climate and land use change on Alpine bird distributions within the forest-shrub ecotone.

POSTER

The effect of prey availability and habitat on breeding performance among urban and rural peregrine falcons

Esther F. Kettel*[1], Louise K. Gentle[1], Richard W. Yarnell[1] & John L. Quinn[2]

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Urban environments present wildlife with multiple challenges, which many species are unable to adapt to. Conversely, some adaptable species have colonised towns and cities globally in response to an increased food availability and nesting opportunities. Whether or not species are actually benefiting from residing in these human-made environments is receiving increasing attention. However, how top-level species respond to urbanisation is poorly understood. The aims of this study were to detect and explain differences in the breeding performance based on food availability of an apex predator, the peregrine falcon (*Falco peregrinus*), in urban and rural environments. Historical breeding data was collected from various raptor groups across Great Britain, dating from 1992 – 2016. The breeding performance of peregrines nesting in urban and rural environments was then compared. The modelled density of 49 bird species (i.e. peregrine prey) and land-use around peregrine nests was compared and the effects on breeding performance was measured to explain differences among environments. Findings indicate that the breeding performance of peregrines was significantly greater in urban-nesters. Indeed, urban peregrines produced just over one more egg, one more egg to hatch, one more young to fledge, and had a higher nest success. Moreover, prey abundance was significantly higher in the urban sites, and is likely to be the paramount reason for the increased breeding performance. In the case of peregrine falcons, urban environments appear to provide not only adequate, but superior-quality alternative habitats to rural landscapes in terms of breeding performance. This research offers evidence that the novel environments humans impose on wildlife can, in fact, provide valuable habitats for some adaptable predators.

Esther Kettel has recently submitted her PhD thesis and is currently a lecturer in Wildlife Conservation at Nottingham Trent University. She has an interest in ecology and conservation, with a recent focus on how birds of prey respond to urbanisation and other land-uses.

POSTER

Validation and performance testing of a laser rangefinder for estimating avian flight in 3D

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Accurate estimation of bird flight characteristics in 3-dimensional space is useful for the assessment of bird responses to man-made structures such as wind turbines. Traditionally, flight activity has been studied using techniques such as observer-based vantage point surveys and line- and point-transects. Recently, these methods have been complemented with telemetry methods, e.g. GPS tagging, and radar. Although built and optimised as an optronic device for military and civil applications, the ornithodolite (based on a rangefinder and integrated digital magnetic compass, with laptop connection for data transfer and recording) can also be used to track and extract bird activity in space and time. However, before tracking instruments are used potential errors or inaccuracies in positional estimation should be assessed and quantified. Accordingly, as a tool for ornithology research, the ornithodolite currently lacks validation data. Remotely-controlled unmanned aerial vehicles (UAVs, a.k.a. drones) have proved useful as test targets in evaluating the performance of other ornithological data collection instruments, such as radar. Here, we describe a method for assessing the accuracy of the ornithodolite in estimating bird position in 3D space, using a dedicated UAV test target. The positional fixes (latitude, longitude and altitude) of the ornithodolite were compared to those derived from a drone-attached GPS tag and barometric altimeter, using the drone's internal GPS and barometer measurements as a reference. Field trials were carried out in open ground and focussed on testing each axis (latitude, longitude, altitude) in isolation and combination. Thus far analysis shows no significant difference in the estimation of drone position between instruments. The ornithodolite is highlighted as a robust instrument in collection of positional data for ornithological research and comparability of different technology platforms in estimating bird 3D space use is emphasised. Future work will focus on validation of the rangefinder beyond positional accuracy.

Nicola Largey is a 2nd year PhD researcher focussing on investigating bird flight characteristics and habitat use in relation to windfarm impacts. She is interested in the application of various technologies to gain novel insights into animal behaviour, particularly in relation to applied ecological problems.

POSTER

Contribution of pond management to avian diversity and abundance on farms in lowland England

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Farmland bird populations in the UK have decreased by 56% since 1970. Intensification of agriculture and associated declines of habitat heterogeneity have been linked to the depletion of the main requirements of farmland birds.

We investigated whether lowland farmland pond management can contribute towards supporting bird populations. Currently, the majority of the UK's lowland agricultural ponds have not been managed for several decades and as a result are highly terrestrialised. Research has shown that managed, open canopy ponds support a higher diversity of aquatic invertebrates, macrophytes and amphibians than unmanaged, terrestrialised ponds. However, the link between farmland pond management and bird usage has been less well studied.

Between May 2016 and April 2017 we investigated the year-round contribution of managed, open canopy and unmanaged, overgrown farmland ponds in Norfolk, towards supporting avian diversity and abundance. Managed, open ponds were found to support a higher species richness and abundance of birds than their unmanaged counterparts. The potential link between synchronised emergent invertebrate hatches and bird activity at both pond management types were subsequently investigated. This revealed that, during the bird breeding season, high numbers of invertebrates emerge from managed ponds, in comparison to very low levels at the unmanaged ponds. This higher invertebrate productivity may be linked to the higher rates of bird activity, including foraging behaviour recorded at managed ponds.

Our results indicate that when managed, farmland ponds can support a greater diversity and abundance of birds and invertebrates.

Jonathan Lewis-Phillips is a NERC Doctorial Training Partnership candidate partnered with both the Natural History Museum and University College London. He is interested in investigating practical ways to mitigate rapidly declining farmland wildlife in the UK.

POSTER

Seabirds and marine plastic debris in the Northeast Atlantic: a synthesis and recommendations for research and monitoring

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The presence of plastic in the marine environment is a globally recognised issue, with far-reaching economic, aesthetic, and environmental consequences. Numerous marine species interact negatively with plastic debris through entanglement, nest incorporation, and ingestion. However, in the Northeast Atlantic, an area of international importance for seabirds, we have little understanding of the spatial and temporal variation of how marine plastic affects different seabird species. To improve our understanding of active interactions between Northeast Atlantic seabirds and marine plastic we reviewed the published and grey literature to obtain information on all known documented cases of plastic ingestion and nest incorporation. We found that of 69 seabird species that commonly occur in the Northeast Atlantic, 34 (49%) had evidence of ingesting plastic. However, information from multiple countries and years was only available for 18 of these species (26%). We found only one published study on nest incorporation, for the northern gannet *Morus bassanus*. For many species, sample sizes were small or not reported, and only 39% of studies were from the 21st century indicating that we actually know very little about the current prevalence of plastic ingestion and nest incorporation for many species. Furthermore, in the majority of studies, the metrics reported were inadequate to carry out robust comparisons among locations and species or perform meta-analyses. This synthesis highlights important gaps in our current knowledge, and can be used to prioritise future research to obtain a more comprehensive and current understanding of how marine plastics are affecting seabirds in the Northeast Atlantic.

Nina O'Hanlon is an ornithologist with a particular interest in seabird ecology and conservation. She is currently a post-doc at the Environmental Research Institute (University of the Highlands and Islands). Previously, she completed a PhD at the University of Glasgow on Herring Gulls. Nina is also the BOU's Social Media Support Officer.

POSTER

Pinpointing what aspect of prey biology drives variation in Black-legged Kittiwake breeding success

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In recent decades, seabird numbers have dropped all around the UK. This is thought to have been caused mainly by a decline in forage fish, in particular the lesser sandeel (*Ammodytes marinus*), which is an important prey for many seabirds. However, there is often not a very strong correlation between coarse-scale sandeel abundances and seabird population dynamics, but instead seabirds may be responding to more fine-scale changes in timing and energy content of the sandeels.

Here, we compare measures of sandeel abundance, energy content and timing with detailed spatially-matched information on black-legged kittiwake (*Rissa tridactyla*) breeding success and diet, with the aim of assessing how sandeel stock changes are reflected in kittiwake diet as well as identifying which sandeel measures best predict kittiwake breeding success. We make use of several empirical datasets as well as output from a bioenergetics model of sandeels.

Knowing what measure of sandeels shows the strongest correlation with kittiwake breeding success is of key importance as different measures, such as for example timing or energy content, may respond differently to changes in climate and in lower trophic levels. This knowledge thus enables us to improve our predictions for how environmental change will impact kittiwakes and other sandeel predators in the coming decades.

Agnes Olin is a PhD student based in Glasgow investigating how environmental impacts on lower trophic levels propagate up through the marine food chain to impact seabirds. She has a particular interest in seabirds and how they respond to environmental change.

POSTER

Genetic diversity and molecular phylogeny of the critically endangered Grenada dove (*Leptotila wellsi*)

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The Grenada dove (*Leptotila wellsi*) is a critically endangered species endemic to the island of Grenada. It exists in three seemingly isolated populations across the island. As an endemic on a small island with a small and decreasing population size this species is a risk from genetic deterioration. Particular risks include inbreeding depression and accelerated loss of genetic diversity resulting from ongoing habitat fragmentation and population isolation. This poses multiple threats such as diminished reproductive fitness and adaptability to environmental change, making it more susceptible to the risk of extinction. This is of particular concern given the threats of anthropogenic disturbance, alien invasive species and climate change to this species. Furthermore, the phylogenetic placement of the Grenada Dove among Columbidae in curently unknown. We conducted a genetic assessment from non-invasively collected feather samples from two of the populations to determine whether there was evidence of genetic connectivity or isolation between these populations. Mitochondrial DNA (mtDNA) markers - partial regions of NADH dehydrogenase subunit 2 (ND2) and cytochrome b (cyt b) - were used to calculate genetic diversity (F_{ST}) within and between the populations to assess genetic differentiation. We also predicted the phylogenetic placement of the Grenada dove within the genus *Leptotila* on the basis of analysis of partial regions of mtDNA sequences. We suggest a long term genetic monitoring programme for each of the existing populations to measure genetic diversity and connectivity across the three known populations.

Catherine Peters is a PhD student studying the application of genetic techniques for conservation of the critically endangered Grenada dove (*Leptotila wellsi*). Her main research focuses are phylogenetics and population genetics. She is particularly interested in how genetic data can be applied to practical avian conservation management strategies.

POSTER

Temporal-spatial adaptation theory of species diversity for future ornithology

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In a rapidly changing world, the role of species richness regularities in addressing challenges faced by society is more important than ever before. We focus on the big picture that stretches across a spectrum of specimen types (the latitudinal cline in species diversity, the asymmetry in species richness between the northern and southern hemispheres, various patterns of species richness along mountain and continental slopes, the higher fidelity of tropical organisms to spatial and temporal habitats etc.) so that they can be used to tackle ever bigger and more pressing questions, including climate change.

We argue that relatively stable environment allows species to move more and more towards specialization with a simultaneous narrowing of their ecological niches that in turn leads to a reduction of niche overlap and greater species packing in communities. In contrast, a wide range of regular environmental changes in time will cause various species to have not only very large, but also widely overlapping ecological niches. The competitive extinction of much of species and a general impoverishment of biota is a predicted outcome of interspecific competition under such conditions. In tropical mountains and on the continental slope, where the environment is stable enough, the degree of its differentiation depends mainly on the steepness of slope. And since the the steepest slopes are tend to be located at intermediate elevations and intermediate bathyal depths, it is there that there are conditions for the highest specialization and closest possible packing of species.

Such a unified theory of species diversity may be refered to as the 'temporal-spatial adaptation theory.' It will allow us to expand our understanding of the main underlying mechanisms responsible for species richness patterns, and provides a framework for new approaches to biodiversity conservation of both different regions and the planet as a whole.

Nadezhda Y. Poddubnaya is a biologist with a main research focus on wildlife ecology and conservation, mainly in forest ecosystems, and in applied issues of understanding the impact of environmental changes on biodiversity, understanding processes in the large-scale distribution of animal distributions, abundance and species richness.

POSTER

How does landfill use affect survival of partially migratory white storks?

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Supplementary feeding of wild species is often undertaken as part of conservation strategies for declining wildlife populations, such as feeders for garden birds or feeding stations for raptors. In addition to purposefully providing food subsidies incidental food resources are made available at open landfill sites. Many species utilise this predictable year-round organic waste resource, such as White storks (*Ciconia ciconia*). In recent decades this previously wholly migratory species established resident populations in Iberia, some individuals staying in Europe during the winter instead of migrating to Africa

This study investigates the effect of landfill site use on the annual survival of white storks, exploring the differences between adults and juveniles. Data with high temporal and spatial resolution was collected from 68 adults and 98 juvenile white storks tracked with GPS/GSM transmitters (deployed from 2012 to 2017). The survival of individuals between lifecycle stages, pre-migratory, migratory and wintering is analysed in relation to proximity of nest to landfill sites and landfill site use. Results from analysis of juveniles show there is no effect of nest proximity to landfill sites on juvenile survival, but use of landfill sites prior to first migration increases survival; 40% more individuals survive to migration if they use landfill sites.

Waste management is becoming more environmentally-friendly, in Europe an EU directive requires open landfill sites in Europe to close in favour of indoor recycling centres. However this will lead to a reduction in food resources for white storks and other bird species that use open landfill sites, e.g. gulls, egrets and kites. The positive impact of landfill sites on white stork survival indicates that population declines are likely once landfill sites are closed. An open discussion on whether access to organic waste should be maintained to support populations of birds that currently thrive around landfill sites is needed.

Kate Rogerson is an ecologist and third year PhD student at the University of East Anglia, interested in the study of movement behaviour with GPS technology and how human modifications to the environment can alter animal behaviour which affects population demographics.

POSTER

Unravelling the wintering areas and morphological differences in populations of migratory passerines in the Afro-Eurasian flyway

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Billions of migratory birds, many of them small passerines, fly thousands of kilometers from their breeding habitats in Europe to non–breeding sites (or "wintering" grounds) in Africa. Despite its importance, understanding of the conditions at wintering grounds of migratory passerines in Africa is limited to qualitative observations. Israel has a unique potential for the study of migratory passerines as an important stop–over site before and after crossing the extensive migration barriers, the Sahara and the Red Sea in a narrow corridor in the flyway connecting Eurasian and African continents. Our aims are to (1) analyse phenological changes in arrival dates to Israel and identify potential causes, (2) map the moulting areas for wintering migratory passerines in the Eurasian-African flyway using stable isotopes from feathers (δ^2H, δ^{13}C and δ^{15}N), and (3) study any morphological differences between potential multiple wintering populations. We expected earlier individuals to have longer wings then individuals of the same species arriving later as a morphological adaptation for efficient longer flight.

Our initial results of arrival dates to Israel show multiple peaks of arrival in some years, which implies multiple wintering populations. We next verify that the peaks are a result of different wintering populations arrived from different areas in Africa using stable isotope analysis for two of the five species sampled (Eurasian Reed Warbler *Acrocephalus scirpaceus* and Eastern Olivaceous Warbler *Hippolais pallida*). Furthermore, we confirmed morphological differences between early and late arrivals to Israel, with earlier arriving individuals having longer wings then individuals of the same species arriving later. We expect to map the wintering distribution of five passerine species and analyse phenological differences in arrival timing to Israel and morphological differences.

Yaara Aharon-Rotman is a postdoc ecologist at Tel Aviv University, Israel with main interest is avian migration, mainly in stopover ecology and how animals prepare themselves for long flights. In light of recent global changes, she is particularly interested in evaluating the responses of migratory birds to varying environmental conditions both at individual and population levels.

POSTER

Foraging behaviour of northern rockhopper penguins north and south of the sub-tropical front: Implications for the species' long-term resilience to environmental perturbations

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Despite the proximity between northern rockhopper penguins' breeding sites in the South Atlantic, the distance of 380 km separating Gough from the main islands of Tristan da Cunha means that Gough is the only breeding site for the species south of the Sub-tropical front placing the island in sub-antarctic waters. Penguins were tracked at sites on either side of the Sub-tropical Front: Nightingale (north) and Gough (south) during their annual cycle in 2012/13 and 2013/14 and again on Nightingale in 2016/2017. Penguins displayed discrete foraging behaviours, distributions, and habitat use during both the breeding and non-breeding seasons. While Nightingale penguins showed high variability in foraging locations during incubation and over-winter migration and dispersed widely across the South Atlantic, penguins on Gough displayed strong directionality with high continuity, travelling south/southeast into the Antarctic convergence.

Northern Rockhopper penguins will face new challenges in the coming decades as climate change continues to alter marine foraging habitat. The most likely threat posed by climate change to the Northern Rockhopper penguin populations are large-scale climatic anomalies in the subtropical Indian and Atlantic Ocean associated with the southward shift of frontal systems and deepening of the thermocline; both secondary to warming the Southern Ocean's surface waters. Consequently, understanding marine habitat use and preferences of populations is essential to predict their long-term resilience to environmental perturbations, and needs to be considered in future conservation planning.

Antje Steinfurth is a Conservation Scientist at the RSPB leading the Darwin Plus funded '*Project Pinnamin* - conserving Northern Rockhopper penguins on Tristan da Cunha'. Her research focuses on understanding the processes that regulate seabird distributions, demography and population dynamics, and applying this understanding to the conservation of threatened populations.

POSTER

Effects of habitat changes on terrestrial bird communities in San Cristobal island, Galapagos archipelago, Ecuador

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Habitat change affect diversity of bird communities, allowing the expansion and dominance of some guilds and species, and the decline or even local extinction of others. This study analysed differences in the diversity of bird communities in the San Cristobal island, Galapagos archipelago, Ecuador, between different habitats on the lowlands (old-growth lowland deciduous forests and suburban and urban green areas) and on the highlands of the island (old-growth seasonal evergreen forest and agricultural areas). We sampled three sites in each habitat using three sampling methods: visual transects, song recording points, and mist netting. Communities on the highlands showed a greater difference in terms of species richness, but not pronounced differences in terms of abundance and frequency. On the highlands, insectivorous endemic species (e.g., Grey Warbler-finch *Certhidea fusca* and Woodpecker Finch *Geospiza pallida*) were mostly restricted to the old-growth forests, while granivorous endemic species were extremely dominant on agricultural areas (e.g., Small Ground-Finch *Geospiza fuliginosa* and Medium Ground-Finch *G. fortis*), as well as introduced species (Smooth-billed Ani *Crotophaga ani*). On the lowlands, species communities were fairly similar in terms of their species richness but some species showed a lower abundance and frequency on the urban and suburban habitats (e.g., San Cristobal Mockingbird *Mimus melanotis*, Galapagos Flycatcher *Myarchus magnirostris*, Small Tree-Finch *Geospiza parvula*). Yellow Warbler *Setophaga petechial* was the only species that showed no variation in their abundance and frequency across all habitats. This study has strong implications for the formulation of conservation strategies and policy-making focused on the management of urban and agricultural areas in San Cristobal island.

Daniel Velarde is student of Biology at Universidad San Francisco de Quito USFQ, Ecuador, with major interests in community ecology and behaviour in birds.

Diego F. Cisneros-Heredia is full-time professor and researcher, director of Laboratory of Terrestrial Zoology, Universidad San Francisco de Quito USFQ, Ecuador

POSTER

Context dependent colonisation of terrestrial habitat islands by a long-distance migrant bird

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Understanding how landscape configuration influences colonisation dynamics has become an important conservation issue in the face of global land use change. Although it is well known that landscape composition and configuration can dictate how individuals disperse through the landscape, individuals can also preferentially choose to colonise a habitat patch or 'habitat island' based on its relative attractiveness within the wider landscape context. Such context-dependent colonisation behaviour has been demonstrated in aquatic island systems, but has rarely been observed in terrestrial habitat islands.

We present results from a large scale 'natural' colonisation experiment designed to test if landscape context predicts colonisation rates in terrestrial habitat islands. We used bioacoustic recorders to detect the spring arrival times and settlement rates of a long-distance migrant bird (Willow Warbler *Phylloscopus trochilus)*, in 23 secondary broadleaf woodlands. Patches varied in their surrounding landscape composition and configuration but were of similar size to control for area-sampling effects. We also controlled for patch 'quality' as far as possible by selecting woodlands with similar tree species composition and vegetation structure. We hypothesised that, after controlling for latitude and longitude, landscape-level factors would be stronger predictors of first arrival and settlement than patch-level metrics. Results agreed with these expectations, and birds arrived and settled earlier in patches surrounded by a low proportion of woodland in the landscape.

These findings suggest that even for a highly mobile, Afro-Palearctic migrant bird, colonisation and settlement rates depend on landscape composition. Since earlier arrival is generally advantageous for migrant birds, we conclude that isolated habitat islands become relatively more attractive when habitat availability in the landscape is low. Future research should investigate if small, isolated habitat islands are acting as ecological traps.

Robin Whytock is a PhD student at the University of Stirling with broad interests in the ecology and conservation of forest birds. His PhD research seeks to understand how biodiversity responds to habitat creation in a landscape context, with the aim of informing landscape-scale conservation and policy.