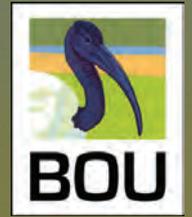


FROM AVIAN TRACKING TO POPULATION PROCESSES



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2017 ANNUAL CONFERENCE

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28-30 MARCH 2017

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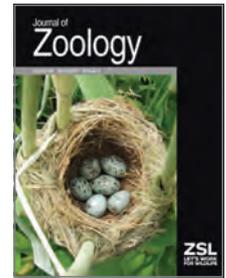
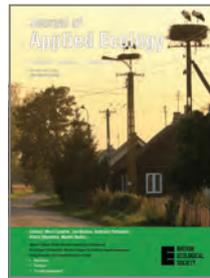
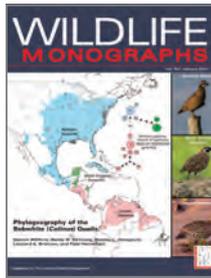
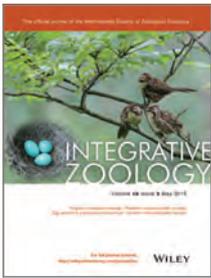
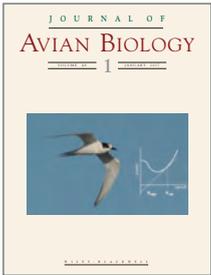
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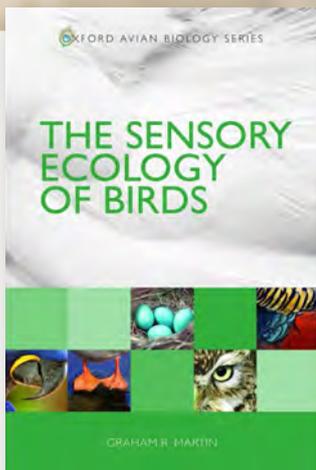
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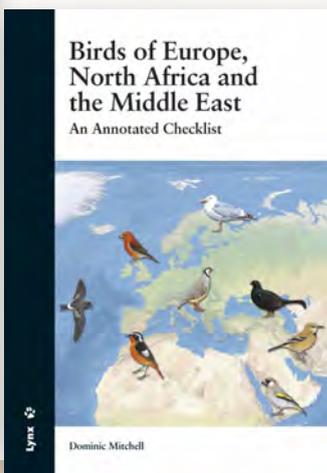
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The Sensory Ecology of Birds
 Graham R. Martin
 (2017)



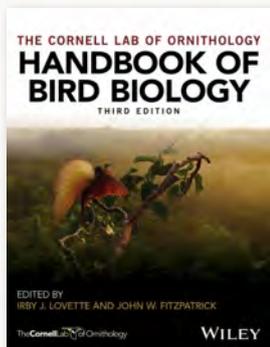
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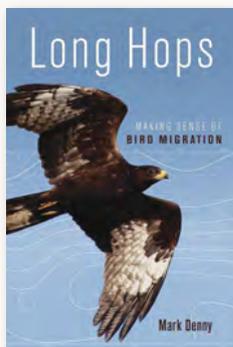


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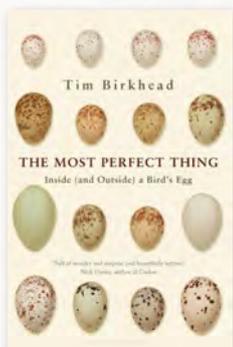
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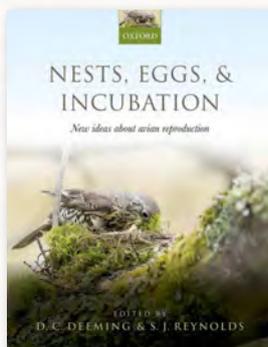
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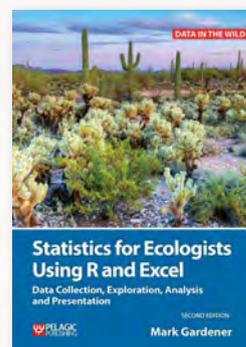
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*Richard and Barbara Means as featured in New Naturalist - 'Farmland Birds' by Ian Newton

#BOU2017

From avian tracking to population processes

28 – 30 March 2017 | University of Warwick, UK



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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

From avian tracking to population processes, a conference organised and delivered by Jen Gill (University of East Anglia), José Alves (University of Aveiro, Portugal), Tómas Gunnarsson (University of Iceland), Aldina Franco (University of East Anglia, UK), Francis Daunt (Centre for Ecology & Hydrology, UK), Steve Dudley (BOU) and Angela Langford (BOU) on behalf of the British Ornithologists' Union. The BOU would like to thank Cat Horswill (BOU Conference Support Officer) and Nina O'Hanlon (BOU Social Media Support Officer) for their assistance in preparing and running the conference, and our social media volunteers Ginny Chan, Virat Jolli and Rahel Bormann. Our thanks also to Francis Daunt, David Douglas, Steve Dudley, Cat Horswill and Nina O'Hanlon for running the BOU ECR workshop.

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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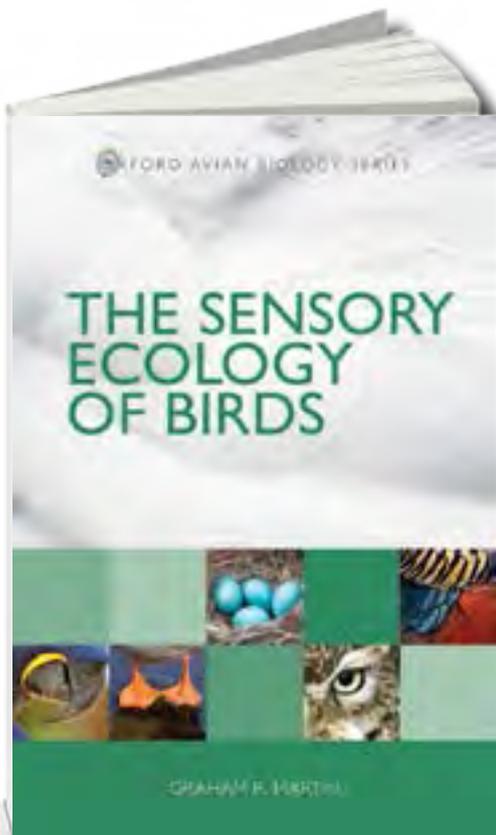
The Sensory Ecology of Birds

Graham Martin, University of Birmingham

- The first integrated synthesis of avian sensory ecology
- Explains the broad principles and takes the reader into the sensory world of birds from an evolutionary and ecological perspective
- Challenges people's assumptions about the sensory worlds of birds and shows how these are tuned to the many perceptual challenges that birds face in their natural environments
- Presents insights into the reasons why birds are often victims of collisions with static structures, vehicles and nets, and suggests mitigations

Understanding how sensory information is used by birds has important applications in conservation, such as providing vital insights into why birds are prone to collisions with structures like power lines and wind turbines, and why so many diving birds become entrapped in nets. A sensory ecology approach suggests how these problems can be mitigated.

This accessible text will be of interest to a wide ornithological readership, from undergraduates to researchers as well as a broader audience of behavioural ecologists and evolutionary biologists.



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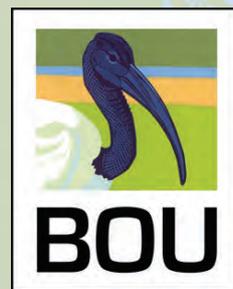
Welcome to #BOU2017 – the BOU's 2017 Annual Conference

The annual BOU conference for 2017 is themed *From avian tracking to population processes*. 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 movements and migrations have fascinated humans for centuries. From local-scale foraging and dispersal to continent-scale migration, the movement and settlement decisions made by birds can have far-reaching consequences for individual fitness and population processes. As the [BOU2015 conference on Avian Tracking](#) demonstrated, recent technological advances have greatly improved our capacity to track individuals on their journeys, while colour-marking and re-sighting studies continue to provide large high-quality datasets on movement and behaviour at a range of scales. This conference will build on this work by exploring the drivers of variation in individual movement, migration and settlement decisions and their consequences for a suite of population processes. Over the coming days, ornithologists and ecologists from a wide range of academic and conservation organisations will explore how tracking individuals can help to address key questions about population processes and their implications for conservation and management.

We very much hope that you enjoy the conference.

Prof. Keith Hamer | BOU President



BOU EVENTS



#BOU2018
**21st CENTURY
ORNITHOLOGY**
CHALLENGES AND
OPPORTUNITIES
27 – 29 March 2018



#BOUSci18
at #IOC2018
**ECOLOGY AND
CONSERVATION**
OF GRASSLAND BIRDS
20 August 2018



PROGRAMME

Presenting authors are listed below. All authors of multiple-author papers are included within the abstracts. Unless stated, the venue is the Ramphal building.

TUESDAY, 28 MARCH 2017

- 1700 Registration opens
1700 – 2200 Time to view posters and exhibitors/shops

1900 **DINNER** (self-service – Rootes Restaurant)

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

PLENARY

Avian dispersal and migration – from individuals to populations

Ken Norris | Institute of Zoology, UK

– 2200 Time to view posters, exhibits, shops and displays (Stamford Court)
No access to Ramphal Building after 2200

– 2330 **BAR** (Rootes Building)

WEDNESDAY, 29 MARCH 2017

0730 **BREAKFAST** (Rootes Restaurant)

0830 Registration opens

Conference opening

Keith Hamer | BOU President | University of Leeds, UK

SESSION 1

INDIVIDUAL MOVEMENT AND SOURCE-SINK DYNAMICS

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

0905 **PLENARY**

Individual consequences of movement behaviour

Judy Shamoun-Baranes | University of Amsterdam, The Netherlands

0945 **Unravelling population dynamics and flyway delineations of the Bewick's Swan**

Rascha Nuijten | Netherlands Institute of Ecology, The Netherlands

1000 **Elucidating source-sink dynamics of the endangered Black-capped Vireo using molecular markers**

Samantha Hauser | University of Louisiana at Lafayette, USA

1015 **Movement, population impacts, and emerging mega-disturbances: burning questions about Spotted Owls and fire**

Gavin Jones | University of Wisconsin-Madison, USA



Weds, 29 March (cont.)

1030 **SPEEDY POSTERS**

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

1045 **COFFEE** (Ramphal foyer)

Time to view posters, exhibits, shops and displays

SESSION 2

MIGRATORY CONNECTIVITY AND POPULATION DYNAMICS

Chair: Jenny Gill | University of East Anglia, UK

1130 **Low connectivity in long-distance migrants and its possible implications for population dynamics under environmental change**

Will Cresswell | University of St Andrews, UK

1145 **The strength of migratory connectivity affects demography of two Neotropical migratory songbirds**

Michael Hallworth | Smithsonian Conservation Biology Institute, USA

1200 **Unravelling migration connectivity in Ortolan Buntings to inform policy in a context of a long lasting hunting/protection conflict**

Frédéric Jiguet | Sorbonne Universités, France

1215 **Effects of breeding versus non-breeding habitat loss and fragmentation on the population dynamics of a migratory songbird**

Caz Taylor | Tulane University, USA

1230 **Local dynamics in a genetic metapopulation of a harvested New Zealand seabird**

Chris Jones | Manaaki Whenua Landcare Research, New Zealand

1245 **LUNCH** (Ramphal foyer)

Time to view posters, exhibits, shops and displays

SESSION 3

DEMOGRAPHY AND CARRY-OVER EFFECTS

Chair: José Alves | University of Iceland & Universidade de Aveiro, Portugal

1400 **PLENARY**

Carry-over effects and fitness in migratory species

Stuart Bearhop | University of Exeter, UK

1440 **Do residents outperform migrants in a warming world? Implications of migratory strategy for individual fitness**

Verónica Méndez | University of East Anglia, UK



Weds, 29 March (cont.)

- 1455 **Overwinter migration strategy influences individual level survival of seabirds during severe winter weather**
Sarah Burthe | Centre for Ecology and Hydrology, UK
- 1510 **Individual temporal flexibility and potential effects on breeding performance in an arctic migrant**
Camilo Carneiro | CESAM, University of Aveiro, Portugal
- 1525 **Isotopic signatures from winter areas predict age- and sex-specific differences in the reproductive success of a migratory passerine bird**
Cosme López-Calderón | University of Seville, Spain
- 1540 **Effect of weather conditions on spring migration of Eurasian woodcock and carry-over effects on breeding**
Kévin Le Rest | Office National de la Chasse et de la Faune Sauvage, France

-
- 1555 **TEA** (Ramphal foyer)
Time to view posters, exhibits, shops and displays
-

SESSION 4

LOCAL TO GLOBAL SCALE DEPENDENCY OF MOVEMENT AND MIGRATION

Chair: Aldina Franco | University of East Anglia

- 1640 **Habitat degradation over-rides compensation for climate change in migration timing of Bar-tailed Godwits**
Jesse Conklin | University of Groningen, The Netherlands
- 1655 **Individual and population responses of long-distance migrating shorebirds to deteriorating staging habitats in the East Asian-Australasian Flyway**
Ying-Chi Chan | University of Groningen, The Netherlands
- 1710 **Arctic-nesting geese can speed up spring migration by benefitting from man-made habitats**
Thomas Lameris | Netherlands Institute of Ecology, The Netherlands
- 1725 **The big picture for pelagic shearwaters: global distribution of *Calonectris* shearwaters across the Mediterranean, Atlantic and Indian Oceans**
Virginia Morera | Institut de Recerca de la Biodiversitat (IRBio), Spain
- 1740 **Presentation of the BOU's Godman Salvin Prize**

-
- 1800 **BOU AGM** (Ramphal lecture theatre)
-

- 1830 **BOU ECR EVENT** (Ramphal rooms 1-13 & 1-15)

NOTE: no access to Ramphal Building after 1930

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From avian tracking to population processes

28 – 30 March 2017 | University of Warwick, UK



Weds, 29 March (cont.)

2000 **CONFERENCE DINNER** (Cancellor's Suite, Rootes Building)
Drinks can be bought at the adjacent bar

- 2330 **BAR** (Rootes Building)

THURSDAY, 30 MARCH 2017

0730 **BREAKFAST** (Rootes Restaurant)

0830 Registrations opens

SESSION 5

EVOLUTION AND DEVELOPMENT OF MOVEMENT AND MIGRATION STRATEGIES

Chair: Jen Smart | RSPC Centre for Conservation Science, UK

0900 **PLENARY**

Settlement decisions and migratory strategies

Tómas Gunnarsson | University of Iceland

0940 **Survival and migratory development of Lesser Spotted Eagles: insights from translocation and lifelong tracking**

Bernd Meyburg | BirdLife Germany

0955 **Variation in migratory strategy within a population cannot be attributed to year, sex, or wintering location: consistency in individual routines points to ontogenetic source?**

Mo Verhoeven | University of Groningen, The Netherlands

1010 **Panarctic polygyny: nomadic movements and large-scale breeding site sampling by male Pectoral Sandpipers**

Bart Kempnaers | Max Planck Institute for Ornithology, Germany

1025 **Migratory birds' response to climate change: reshaping of migratory routes and flyways**

Elham Nourani | Nagasaki University, Japan

1040 **COFFEE** (Ramphal foyer)

Time to view posters, exhibits, shops and displays

SESSION 6

DISPERSAL, SETTLEMENT AND FITNESS CONSEQUENCES

Chair: Francis Daunt | Centre for Ecology & Hydrology, UK

1110 **Evolutionary consequences of nonrandom dispersal in a spatially structured population**

Carlos Camacho | Estación Biológica de Doñana, Spain

1125 **Linking parasitism and life-history: an energetics approach**

Olivia Hicks | University of Liverpool, UK



Thurs, 30 March (cont.)

- 1140 **Movement strategies of non-breeding Ravens**
Matthias Loretto | University of Vienna, Austria
- 1155 **The influence of environmental predictability on individual foraging behaviour**
Alice Trevail | University of Liverpool, UK
- 1205 **Sex-specific three-dimensional foraging behaviour of Northern Gannets**
Jude Lane | University of Leeds, UK
- 1220 **Age-related differences in the foraging behaviour of a long-lived marine predator**
James Grecian | University of Leeds, UK
- 1235 **Presentation of the BOU's Union Medal**

-
- 1300 **LUNCH** (Ramphal foyer)
Last chance to view posters, exhibits, shops and displays
- 1430 Voting for best ECR presentations close

SESSION 7

CONSERVATION AND MANAGEMENT IMPLICATIONS OF MOVEMENT BEHAVIOUR

Chair: Tómas Gunnarson | University of Iceland

- 1430 **Evidence-based evaluation of in situ and ex situ management for the sustainable management of hunted Asian Houbara**
Paul Dolman | University of East Anglia, UK
- 1445 **Consistency in the migratory behaviour of great shearwaters: implications for conservation**
Teresa Militão | Universitat de Barcelona, Spain
- 1500 **Assessing the consequences of habitat loss and degradation in a long-distance migratory shorebird**
Yaara Aharon-Rotman | Deakin University, Australia
- 1515 **Long-term changes in the demography and conservation status of an Arctic-breeding migrant: insights from monitoring, marking, and modelling**
Kevin Wood | Wildfowl & Wetlands Trust, UK
- 1530 **Close of conference**
Keith Hamer | BOU President | University of Leeds, UK

AFTERNOON TEA (Ramphal foyer)
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, 28 MARCH, 2030 h

PLENARY

Avian dispersal and migration – from individuals to populations

Ken Norris

Institute of Zoology, UK

ken.norris@ioz.ac.uk

A small lump of rock off the north coast of Mauritius called Round Island (RI) is leading the way in the whole ecosystem restoration of islands. It is also home to an enigmatic population of petrels that consists of at least three different species inter-breeding in the same location (one from the Atlantic and two from the Pacific). This provides a great opportunity to see how birds with very different eco-evolutionary origins behave in a common environment. To unravel the ecology of this system we have been combining tracking, genetic and demographic data, focusing mainly on the causes and consequences of large-scale migration/movement behaviour. Our genetic data shows that RI is part of dispersal system including islands across three ocean basins, and that RI petrels are a hybridizing mix of perhaps four species. Our tracking data has revealed extraordinary individual variation in migration behaviour, which also appears to be highly repeatable. Initial analyses suggest both genes and the environment are related to this behaviour. Migration behaviour affects exposure to environmental stressors, and we show interesting and contrasting effects of tropical cyclones on survival. Taken together, these results have potentially profound implications for the conservation of the marine environment, particularly how we identify and protect hotspots for pelagic, apex predators. None of this work would have been possible without advances in tracking technology, especially the development of software that now enables the processing of large volumes of data.

Ken Norris is currently Director of Science at the Zoological Society of London, a job that apparently requires him to behave like a responsible adult. He has been involved in work on the ecology and conservation of birds in Mauritius for over 15 years, which plays an important role in preserving what little sanity he has left! All the credit for this work should definitely go to his collaborators.....

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WEDS, 29 MARCH, 0905 h

PLENARY

Consequences of individual movement strategies

Judy Shamoun-Baranes

University of Amsterdam, The Netherlands

shamoun@uva.nl

Movement is a fundamental aspect of the life history of birds, influencing species distributions, interactions, population dynamics and ecosystem functioning. In order to survive and reproduce birds must move efficiently, through and across very heterogeneous environments. Understanding of the complex factors and the interactions that influence avian movement can provide insight into whether or not birds can keep up with environmental change and help resolve increasing conflicts between humans and wildlife. Using examples from different study systems, this presentation will show how intrinsic and external factors influence movement. The integration of measurements of movement (e.g. GPS, Radar, visual observations), the environment and models is used to understand potential short and long term consequences of flight behaviour and movement strategies scaling up from individuals to populations. Challenges and opportunities for linking individual behaviour to population processes will be explored. Furthermore, this presentation will highlight some examples of knowledge utilization to help reduce human-wildlife conflicts, engage the public and foster fascination for science and the natural world around us.

Judy Shamoun-Baranes is an assistant professor in the Computational Geo-Ecology group at the University of Amsterdam. Her research is interdisciplinary combining expertise from ecology, earth and atmospheric science and computer science, and utilizes high resolution GPS tracking (www.uva-bits.nl) and radar measurements. She is the vice-chair of the e-COST Action “the European Network for the Radar Surveillance of Animal Movement” (www.enram.eu). She coordinates an international graduate course “Animal Movement Analysis” and greatly enjoys public outreach activities.



WEDS, 29 MARCH, 0945 h

Unravelling population dynamics and flyway delineations of the Bewick's Swan *Cygnus columbianus bewickii*

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The Bewick's Swan *Cygnus columbianus bewickii* is a long-distance migrant breeding in the Eurasian tundra. In the past two decades, the flyway population that winters in NW-Europe has declined from 30.000 to 15.000 individuals; reasons remain mostly unknown. Interestingly, in the same period, Bewick's swans started to winter in rapidly increasing numbers in the Evros Delta in Greece. Could these developments be to some degree linked?

In order to investigate the causes of the decline of the Bewick's swans wintering in NW-Europe we analysed changes in survival and fecundity over time, and studied the potential of emigration to Greece as a contributor to this decline. For the first objective we analysed 47 years of demographic data within an Integrated Population Model (IPM) framework. For the second objective 30 Bewick's swans wintering in NW-Europe were equipped with GPS-GSM neck collars last winter.

The preliminary results from the IPM showed a constant adult survival, a small increase in juvenile survival and a small decrease in fecundity over time. Future analyses will show whether these trends are sufficient to explain the rapid decrease in numbers in NW-Europe or whether other processes, such as emigration to a different flyway, might be involved.

In the past few years, previously marked individuals have sporadically been resighted in the Evros Delta in Greece. We hypothesize that the incidence of this emigration has increased in recent years. The first tracks from the 30 tagged Bewick's swans will help estimate the emigration rate from the NW-European flyway population to another wintering site. Evidence for such a connection to NW-Europe is currently lacking.

The results illustrate the benefit of combining avian tracking with population demographic analyses in order to delineate the flyway population and unravel the dynamics of a migratory bird species.



Rascha Nuijten is a biologist with a main interest in ecology and conservation. Currently she studies the decline in the NW-European population of Bewick's Swans by looking and changes in survival, breeding success and phenology over time. She uses GPS-tracking, genetic analyses and theoretic models to answer research questions on the population level.

WEDS, 29 MARCH, 1000 h

Elucidating source-sink dynamics of the endangered Black-capped Vireo *Vireo atricapilla* using molecular markers

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Early successional habitats, maintained through periodic disturbances, are ephemeral in nature. Thus dispersal is critical for populations to persist through colonization of newly formed habitat. Through habitat fragmentation and loss, caused by human development and disturbance suppression, populations become more isolated and are more likely to go extinct (DeGraaf and Yamasaki, 2003; Trani et al., 2008). Small, isolated populations are especially at risk of extinction due to mutational meltdown, inbreeding depression, and loss of adaptive potential (Keyghobadi, 2007). Therefore, dispersal to maintain gene flow is crucial to a species future.

Due to widespread fragmentation and previous bottlenecks, reduced genetic variation and gene flow have already been detected in populations of Black-capped Vireos (Athrey et al., 2012). Demographic studies have suggested that there may be source-sink dynamics but logistical restraints have prevented gene flow, crucial to population dynamic studies, from being directly studied. We used molecular markers to elucidate the population dynamics of the Black-capped Vireo in central Texas surrounding Fort Hood, which houses the largest and most stable breeding population. We used microsatellite and SNP markers to gain insight into gene flow among populations and modelled a series of population dynamic scenarios using approximate Bayesian computation.

We found asymmetrical migration rates among populations but no evidence for isolation by distance. A lack of isolation by distance is unsurprising as this species is highly vagile, so either behavioral or landscape factors are responsible for the restricted and asymmetrical gene flow. Our data suggests that there may be source-sink dynamics, with Fort Hood as the source population. As the Black-capped Vireo is widely threatened by fire suppression and habitat fragmentation, it is an excellent model to better understand the threats that early-successional species face. Additionally, the results can be applied for conservation for the endangered species.



Samantha Hauser is a doctoral fellow at the University of Louisiana at Lafayette who is interested in wildlife ecology and landscape genetics. Specifically, she is interested in applying landscape genetic techniques to gain insight into population dynamics for conservation and management purposes.

WEDS, 29 MARCH, 1015 h

Movement, population impacts, and emerging mega-disturbances: burning questions about spotted owls and fire

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We live in a world where ecological mega-disturbances are increasingly common, yet their impacts on avian populations remain a source of uncertainty. In western North America, more frequent and severe “megafires” in dry forests following a century of fire suppression and climate change have prompted proposals to restore historical fire regimes and ecosystem resilience. Restoration efforts that reduce tree densities (eg via logging) could have collateral impacts on declining old-forest species, but whether these risks outweigh the potential effects of large, severe fires is unknown. We demonstrate the effects of a 2014 severe megafire on an iconic old-forest species, the Spotted Owl *Strix occidentalis* in California, USA using a before-after control-impact natural experimental design. The probability of owl site extirpation was seven times higher after the fire (0.88) than before the fire (0.12) at severely burned sites, contributing to the greatest annual population decline observed during our 23-year study. After the fire, we collected 1085 nocturnal foraging locations from nine owls equipped with mini-GPS backpacks and found that owls avoided severely burned forest, but used unburned and moderately-burned forest in proportion to availability. Our study suggests that megafires pose a threat to the declining spotted owl and other old-forest species, and we conclude that restoring historical fire regimes could benefit both old-forest species and the dry forest ecosystems they inhabit in this era of climate change.

Gavin M. Jones is a graduate student with a main research focus on fire and climate change ecology in forested ecosystems. He is particularly interested in using ecological modelling to address challenging and broad-scale conservation questions.



WEDS, 29 MARCH, 1130 h

Low connectivity in long-distance migrants and its possible implications for population dynamics under environmental change**Will Cresswell¹, Tom Finch², Simon Butler², Aldina Franco², Emma Blackburn¹, Malcolm Burgess³, Benedictus Freeman⁴, Alice Risely⁵, Arin Izang⁴, Sam Iwande⁴ & Chris Hewson⁶**¹ Centre for Biological Diversity, University of St Andrews, St Andrews, Fife KY16 9TH, UK² University of East Anglia, Norwich, NR4 7TJ, UK³ RSPB Centre for Conservation Science, The Lodge, Sandy, Beds SG19 2DL, UK⁴ AP Leventis Ornithological Research Institute, Jos, Nigeria⁵ Centre for Integrative Ecology, Deakin University, Geelong, VIC 3216, Australia⁶ British Trust for Ornithology, The Nunnery, Thetford, IP24 2PU UK

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Estimating the extent to which long-distance migrant populations spread out and mix during the non-breeding season (migratory connectivity) is essential for understanding their population dynamics in the face of global change. For example, a strategy of wide migratory spread should pre-adapt migrants for climate-driven shifts in habitat. We illustrate this with a case study of Whinchats that show very low migratory connectivity. We then test whether long distance migrant bird populations (712 individuals from 98 populations of 45 species, from tagging studies in the Neotropic and Afro-Palearctic flyways) have a general strategy of wide migratory spread. We explore the generality of this with a simple null model that evaluates the degree to which migratory spread is predicted simply by land availability as opposed to species identity. Long-distance migrant populations, on average, spread out over continent-wide scale non-breeding areas. Variation in population-level spread was better predicted by the availability of land to the south of the breeding site than by species or family identity. Migrants from different breeding populations tended to mix during the non-breeding season, though segregation was maintained in species with larger non-breeding ranges (and, to a lesser extent, low population-level spread). The conservation implications of generally low connectivity are that the loss of any non-breeding site will have a diffuse but widespread effect on breeding populations of a species. Although low connectivity should engender population resilience to climate change driven shifts in habitat, we suggest it may increase susceptibility to habitat loss, as a greater proportion will miss their shrinking target habitat. This would lead to opposing connectivity optima: we hypothesise that migrants cannot adapt to both, which may help explain the decline of migrants with ecologically diverse traits.

Will Cresswell is Professor of Biology at St Andrews University. He is currently interested in the factors determining the density, distribution and overwinter survival of Palearctic migrants in Africa to help address the pressing conservation question of why migrant birds are declining globally and what we might be able to do about it.



WEDS, 29 MARCH, 1145 h

The strength of migratory connectivity affects demography of two Neotropical migratory songbirds**Michael T. Hallworth^{1*}, T. Scott Sillett¹, Nicholas L. Rodenhouse² & Peter P. Marra¹**¹Smithsonian Conservation Biology Institute – Migratory Bird Center, Washington, D.C. 20008, USA²Wellesley College, Wellesley, MA. 02482, USA

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Understanding how the annual cycle of migratory songbirds shapes demography and population dynamics necessitates that we know where individuals are throughout the year. The miniaturization of archival tracking technology such as light-level geolocators and GPS units has allowed researchers to make direct links between the different phases of the annual cycle. We deployed archival light-level geolocators on the Black-throated Blue Warbler *Setophaga caerulescens* and the Ovenbird *Seiurus aurocapilla*, two migratory songbirds breeding within Hubbard Brook Experimental Forest, N.H. to quantify the strength of migratory connectivity and identify where they spend the non-breeding season. We then used remotely sensed data of their wintering locations to make inferences about how climatic factors experienced during the non-breeding season correlate with demographic parameters the subsequent breeding season. We predicted that the non-breeding season climatic variables would have a greater influence on demography when migratory connectivity is strong. We found that the Black-throated Blue Warbler exhibits weak connectivity while the Ovenbird exhibits moderate connectivity with the majority of individuals wintering on the islands of Cuba and Hispaniola. The amount of precipitation on the islands of where these populations winter, (Jamaica, Cuba and Hispaniola) was positively correlated with demographic parameters at both local (plot-level) and landscape (watershed) scales. As predicted, non-breeding climatic variables had a greater influence on Ovenbirds who exhibited stronger migratory connectivity than the Black-throated Blue Warbler. These findings suggest that environmental conditions experienced throughout the annual cycle contribute to variation in demographic rates observed on the breeding grounds. Demographic studies of linked populations during both the breeding and non-breeding grounds will greatly improve our understanding of how seasonal interactions shape populations and ultimately how populations respond to a changing climate.

Michael T. Hallworth is a postdoctoral fellow at the Smithsonian Conservation Biology Institute's Migratory Bird Center in Washington, D.C. His current research integrates movement and population ecology to better understand factors influencing population dynamics.



WEDS, 29 MARCH, 1200 h

Unravelling migration connectivity in Ortolan Buntings to inform policy in a context of a long lasting hunting/protection conflict

Frédéric Jiguet^{1*}, Caroline Moussy¹, Raphaël Arlettaz², Hans-Günther Bauer³, Viktor Belik⁴, Michel Alexandre Czajkowski⁵, José Luis Copete⁶, Svein Dale⁷, Valery Dombrovski⁸, Jaanus Elts⁹, Yves Ferrand¹⁰, Guy M. Kirwan¹¹, Romain Lorrillière¹, Simonas Minkevicius¹², Markus Pihä¹³, Gunnar Selstam¹⁴, Michał Skierczyński¹⁵, Jean-Philippe Sibley¹⁶ & Aleksandr Sokolov¹⁷

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The Ortolan Bunting *Emberiza hortulana* has been rapidly declining in Europe during the last decades, while still hunted in south-western through a dedicated traditional practice for gastronomic purposes. A joint research programme was launched at a continental scale in 2012 and ended in 2016, with the aim to identify migration flyways and connectivity of breeding/wintering populations, to finally estimate the size and trend of populations using the western Atlantic flyway - hence potentially sampled by French hunters. We sampled >200 migrants in south-west France and in Kuwait, and >1000 breeders from across the European breeding range (Spain, France, Serbia, Germany, Poland, Lithuania, Estonia, Finland, Sweden, Norway, Belarus, Russia). Based on the crossed study of stable isotopes (deuterium) in European- and African-grown feathers (to assign migrants to breeding areas, and breeders to wintering areas), microsatellite markers (to assign western and eastern migrants to genetically-mapped breeding



populations) and light loggers (0.5 to 1g, from Migrate Technology and Sempach, to visualize migration tracks of known breeders from across the range), we were able to unravel the migration strategy of the species, hence the migration connectivity between breeding and wintering areas through migration flyways. Birds from all Russian studied populations used an eastern flyway to winter around Ethiopia. All other birds wintered in western Africa, around Guinea, though reached these areas by two distinct western flyways, western breeding populations using an Atlantic flyway, while eastern populations crossed central Europe to further reach Africa by the Mediterranean. We thus identified migration divides and quantified the size and trend of the populations using the western Atlantic flyway. Knowing these metrics for populations migrating by south-western France, and acknowledging that French hunters probably capture between 10 and 30 000 ortolans annually, we further tested if putting an end to these illegal hunting practices could decrease the extinction risk faced by these populations. Results from these models finally informed the French politics and hunters to take appropriate decisions concerning Ortolan's future and the application of the Birds Directive in France.

Frédéric Jiguet is professor at MNHN and director of the CRBPO (French ringing scheme), in a research unit dedicated to Conservation Sciences. His researches focus on impacts of global change (land use changes and climate changes) on biodiversity, migration, population and community dynamics, and the conservation ecology of endangered species.

WEDS, 29 MARCH, 1215 h

Effects of breeding versus non-breeding habitat loss and fragmentation on the population dynamics of a migratory songbird

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Many migratory species are in decline and understanding these declines is challenging because individuals occupy widely divergent and geographically distant habitats during a single year and therefore populations across the range are interconnected in complex ways. Network modeling has been used to show, theoretically, that shifts in migratory connectivity patterns can occur in response to habitat or climate changes and that habitat loss in one region can affect sub-populations in regions that are not directly connected. Here, we use a network model, parameterized by integrating long-term monitoring data with direct tracking of ~100 individuals, to explain population trends in the rapidly declining Wood Thrush *Hylocichla mustelina*, and to predict future trends. Our model suggests that species-level declines in wood thrush are driven primarily by tropical deforestation in Central America but that protection of breeding habitat in some regions is necessary to prevent shifts in migratory connectivity and to sustain populations in all breeding regions. The model illustrates how shifts in migratory connectivity may lead to



unexpected population declines in key regions. We highlight current knowledge gaps that make modeling full-life cycle population demographics in migratory species challenging but also demonstrate that modeling can inform conservation while these gaps are being filled.

Caz Taylor is a population ecologist with a focus on developing theory that can be used to further understanding of movement and population dynamics of migratory species. She is particularly interested in applying theory to real species to inform conservation.

WEDS, 29 MARCH, 1230 h

Local dynamics in a genetic metapopulation of a harvested New Zealand seabird

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The Grey-faced Petrel (GFP; *Pterodroma gouldi*), a large gadfly petrel breeding on headlands and islands off the east coast of northern New Zealand, is culturally significant to Māori who traditionally harvested pre-fledging chicks (“muttonbirds”). In a six-year study of the species, we collected DNA samples from 390 birds at 13 colonies across their NZ breeding range to examine population genetic structure. We found high diversity in mitochondrial DNA in all colonies, but no genetically distinct populations, i.e. a single metapopulation. This suggests that non-physical barriers such as high rates of natal philopatry and mate fidelity do not facilitate geographic genetic structuring in the population. The species forages at large scales: adults from breeding colonies on NZ’s Ruamaahua Islands ranged up to 38,160 km across the southwestern Pacific Ocean and Tasman Sea and were located almost exclusively over offshore waters >1000 m deep with similar distributions across years and high spatial overlap (foraging “hotspots”). Our analyses of seabird population recovery following eradication of introduced predators from islands found the most influential recolonization driver was the distance to a source population, with little recolonization without a source population 25 km away. Colony growth was most affected by metapopulation status, with little colony growth in declining species. In contrast to this evidence for metapopulation dynamics, our surveys of 5 GFP island breeding colonies emphasised the importance of local drivers of population growth. Breeding success rates on our island groups ranged between 11% and 29% leading to contrasting local dynamics. Productivity was unaffected by the presence of small Polynesian rats, *Rattus exulans*, but declined with increasing local burrow density across all predator-free islands. This variation in productivity may be linked to the islands’ restoration histories and suggests that



data from one location should be used cautiously when guiding management of the same species elsewhere.

Chris Jones is a wildlife ecologist specialising in vertebrate population ecology. He has worked on a wide range of applied projects, notably guiding the re-establishment of traditional harvests by Māori and exploring the impacts of invasive mammals on New Zealand's endemic species.

WEDS, 29 MARCH, 1400 h

PLENARY

Carry-over effects and fitness in migratory species

Stuart Bearhop

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Over the last 10 years it has become clear that carry-over effects can explain a significant amount of variation among individual animal life histories. Carry-over effects occur when individuals make the transition between seasons/time points in different states that subsequently affect individual performance. However, the field is very much still in its infancy, there is some confusion as to what a carry-over effect is and substantial knowledge gaps remain.

I will discuss what a carry-over effect is (and what it is not) and explore some of the traits (focusing on the migratory lifestyle) that likely increase their impact drawing on work from passerine and wildfowl study systems as examples. Specifically, I will cover: the distinction between carry-over effects and other downstream processes and why this is important; the problem of separating intrinsic effects (such as individual “quality”) from carry-over effects; the focus on energy as the main currency; some of the traits that likely increase the importance of carry-over effects. I will close with an outline of where we might take these investigations in the future.

Stu Bearhop is a Professor of Animal Ecology at the University of Exeter's Centre for Ecology and Conservation. He has been working on bird populations for over 20 years, with a focus on migration and foraging ecology. He is particularly interested in the causes and consequences of intra-population variation in behaviours and the application of stable isotope techniques in ecology. He manages a large research group, working at sites all over the world including: UK, Republic of Ireland, Cyprus, the Azores, mainland Portugal, Northern Siberia, Michigan (US), Bahamas, Canadian Arctic, Iceland and the Sub-Antarctic (New Zealand, South Georgia and the Falklands).



WEDS, 29 MARCH, 1440 h

Do residents outperform migrants in a warming world? Implications of migratory strategy for individual fitness.

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One of the most widely reported responses to environmental and climatic change in recent years is changes in migratory behaviour of bird species, and particularly advances in the timing of migration and breeding in response to earlier spring warming. These advances could be driving changes in the relative fitness associated with different migratory strategies, and in the frequency of residents and migrants. For example, earlier spring warming could benefit residents and early-arriving migrants, if subsequent earlier nesting is more successful and/or if they have more time for replacement clutches following nest loss. Changes in migratory behaviour can thus potentially alter the distribution and abundance of non-breeding populations, depending on (1) the implications for the relative fitness of individuals with differing migratory strategies and (2) the factors influencing the initiation and maintenance of individual migratory strategies. We address these issues in Eurasian oystercatchers breeding in Iceland, a partially migrant population where changes in the number of resident individuals have recently been observed. First, we identify migrants and residents through colour-ring resightings and comparisons of feather stable isotope ratios. We then assess the implications of migratory strategy for individual fitness, by quantifying variation in timing of nesting, the frequency and timing of re-nesting, hatching and fledging success between residents and migrants.

Dr Verónica Méndez is a conservation ecologist interested in understanding the consequences of global environmental change for biodiversity. My current post-doctoral research at UEA, in collaboration with University of Iceland and University of Aveiro, investigates individual level responses to environmental changes, and particularly changes in migratory behaviour, and associated fitness outcomes in a population of Eurasian oystercatchers in Iceland.



WEDS, 29 MARCH, 1455 h

Overwinter migration strategy influences individual level survival of seabirds during severe winter weather**Sarah Burthe¹, Jane Reid², Hannah Grist², Jenny Sturgeon², Mark Newell¹, Sarah Wanless¹ & Francis Daunt¹**¹ Coastal Seas Ecology Group, Centre for Ecology and Hydrology, Bush Estate, Penicuik, EH26 0QB, UK² School of Biological Sciences, Zoology Building, University of Aberdeen, Tillydrone Avenue, Aberdeen, AB24 2TZ, UK

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Migration is a critical life history trait with profound effects on individual fitness. Partial migration, where a proportion of individuals exhibits seasonal migration and a proportion remains resident throughout the year, is widespread across taxa. However, a critically important question in population ecology is whether the relative fitness of resident and migrant individuals may be modulated by environmental conditions. Climate models predict an increase in climate variability and frequency of extreme weather events, which may have profound but non-homogeneous effects on demography. In partial migrants heterogeneity might occur due to spatial variation in conditions or intrinsic differences between residents and migrants, and impacts on individuals may depend on whether migration strategy is fixed or flexible. Yet few studies have considered how extreme weather may affect individual migration strategies and associated fitness.

Here, we quantified the consequences of severe winter weather on a population of European Shags *Phalacrocorax aristotelis*, a partially migratory species. Resightings of individuals carrying unique colour-rings since 2009, have resulted in >30,000 sightings throughout the year and a powerful system for quantifying the effects of extreme weather on migration strategy and associated demography. Two severe winter mortality events (>1000 corpses recovered) occurred across the north-east coast of the UK in 2012-13 and 2013-14, associated with extreme winter weather. We investigated whether winter migration strategy prior to the extreme winters was linked to survival, and whether migration strategy altered during or following winters with extreme weather.

We found that residents had lower survival than migrants (31% survived compared to 60% migrants) during the first extreme winter, but higher survival in the second (76% vs 64%), with similar survival over non-extreme winters. Most birds did not change their migration strategy either during or after the winters with extreme weather (77%). A proportion altered their migration strategy, with timing dependent on the initial strategy. More migrants changed strategy than residents and there was a tendency for birds that changed strategy to either revert back to or remain resident. Our study demonstrates that extreme weather can have important effects on migration strategy and demography, suggesting potentially profound implications of future increases in the frequency of extreme weather on populations of mobile species.



Sarah Burthe is an ecologist with a main research focus on understanding variation in individual life-histories and how intrinsic and extrinsic parameters, including factors such as parasitism, migration strategy and climate, affect individual level fitness and drive population dynamics.

WEDS, 29 MARCH, 1510 h

Individual temporal flexibility and potential effects on breeding performance in an arctic migrant

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Changes to species phenology, demography and distribution have been widely reported in recent years with attempts to understand these patterns mostly tackled at the species level. However, individual level changes are key to mechanistically understand those patterns. Migratory birds show advances in laying dates due to warming temperatures and although several migratory wader populations have demonstrated some level of flexibility, individuals of this group tend to be highly consistent in time and space throughout the annual cycle. Nevertheless, at higher latitudes, where breeding conditions are only suitable for a short period of time, it might be expected that individuals lay as early as possible to maximize the available time for successfully raising young.

The Icelandic Whimbrel *Numenius phaeopus islandicus* is a long distance migrant that breeds mostly in Iceland and undertakes long flights to/from the wintering areas in West Africa, with some individuals making a stopover in Western Europe. The Icelandic summers of 2015 and 2016 were considerably colder and warmer than average, respectively, providing a unique opportunity to investigate the population and individual flexibility in timing of breeding and its potential effects on breeding success and timing of subsequent migration.

Here we explore (1) the level of population and individual flexibility in timing of breeding, (2) the consistency in timing of migratory stages (departure and arrival from/to winter and breeding sites) and (3) the potential effect of spring migration strategy and timing on breeding success. We found that although the population laying dates distribution did not differ between 2015 and 2016, individuals changed their laying dates for up to 12 days. Whimbrels were less consistent on their timing of departure from Iceland than from the wintering areas, and their arrival to Iceland was relatively flexible, potentially influencing subsequent breeding success.

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).

WEDS, 29 MARCH, 1525 h

Isotopic signatures from winter areas predict age- and sex-specific differences in the reproductive success of a migratory passerine bird

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We measured stable isotopic signatures from feathers ($\delta^2\text{H}$, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$) moulted in Africa and used it as a proxy of environmental conditions House Martins *Delichon urbicum* experienced in their winter habitat. We used path analysis to discern between direct and indirect effects of environmental conditions experienced in winter on body condition, laying date and the subsequent reproductive success. We conducted separate analyses for individuals belonging to different ages (yearling vs ≥ 2 years old individuals, i.e. experienced birds) and gender classes. We found that $\delta^2\text{H}$ indirectly affected the number of fledglings raised by experienced-males in the subsequent breeding season, but that was not the case for young-males. Contrary, environmental conditions from winter areas did not affect reproductive success of neither experienced nor young females. The indirect effect of $\delta^2\text{H}$ on experienced-male breeding success, was mostly mediated by the direct effect of $\delta^2\text{H}$ on body condition. We also found direct effects of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ on the body condition of young-males, and direct effects of $\delta^2\text{H}$, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ on their breeding phenology. However, that was not translated into a significant indirect effect on young-male breeding success. In ecological terms young-males wintering in open habitats with a higher rainfall, such as seasonal savannahs, were in better body condition and reproduced earlier during the posterior breeding season than young-males wintering in equatorial close broadleaf forests with lower rainfall. Furthermore, experienced-males wintering in habitats with higher rainfall were in better body condition and produced a higher number of offspring during the subsequent breeding season. These findings will help to understand the migratory ecology of the study species, which is required to implement effective conservation measures for this declining aerial insectivore.



Cosme López Calderón is a PhD student with a main research focus on migratory ecology of passerine birds and global change biology. He is particularly interested in migratory connectivity and carry-over effects, in order to understand the migratory ecology of species under conservation concern.

WEDS, 29 MARCH, 1540 h

Effect of weather conditions on spring migration of Eurasian Woodcock and carry-over effects on breeding

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Bird migration corresponds to critical periods in birds' fitness and the development of tracking technologies allows investigation of aspects of migration on population dynamics. The Eurasian Woodcock *Scolopax rusticola* is widely hunted in Europe, with likely more than 2.5 million individuals shot per year. Understanding the mechanisms driving its population dynamics is critical to ensure sustainable population management. In March-May, woodcock migrate from south-west to north-east Europe over thousands of kilometres. This period is expected to be important for upcoming breeding because it determines the timing of arrivals and the level of energetic reserves available when reaching the breeding grounds.

From 2012 to 2016 winters, 83 woodcock were fitted with Argos satellite tags in Western Europe (59 in United-Kingdom and 24 in France). During the spring migration period, we study the effect of weather conditions on the probability of continuing migration, at the individual level by using generalized linear mixed models. Then we investigate its repercussions on arrival dates at the breeding ground and on several breeding success indexes, e.g., ratio juveniles/adults and the percentage of early brood in autumn, available from ringing programs.

Results suggested that wind is the main variable driving spring migration decision of woodcock, with favourable winds greatly increasing the probability of continued migration. High temperatures and atmospheric pressures also reduced stop-overs times. Conversely overcast sky diminished migration activity, delaying arrival at breeding grounds.

These results reveal that the weather conditions during spring migration affect the timing of arrival, which in turn may affect breeding success. However, no significant variation in breeding success indexes was found according to weather conditions incurred during migration. Carry-over effects of migration



costs on breeding are thus likely to be weak for woodcock. The main factors affecting breeding success are more likely to occur during the breeding period itself.

Kévin Le Rest is a young scientist in spatial ecology, population dynamic and management of hunted species. His main research relies in the proposal of relevant methods in order to analyse wildlife data in space and time. He is currently responsible for woodcock and snipes monitoring at the ONCFS.

WEDS, 29 MARCH, 1640 h

Habitat degradation over-rides compensation for climate change in migration timing of Bar-tailed Godwits

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The capacity for long-distance migratory birds to adaptively respond to phenology changes on the breeding grounds is thought to be limited by their rigid annual programs and a lack of reliable cues from the non-breeding grounds. Despite exceptional individual consistency in migration timing, mean departure date of Bar-tailed Godwits *Limosa lapponica baueri* from New Zealand has advanced by more than four days since 2008. Long-term monitoring of marked godwits shows that this has occurred largely through individual plasticity, rather than by differential mortality with replacement by early-migrating young birds. During this 8-year period, the earliest date of snow-free tundra at Alaska breeding sites has advanced by ≥ 7 days, implying that timing of godwits migration has partially adapted to changing breeding phenology. However, geolocator-tracking of two godwit cohorts (28 tracks of 19 birds in 2008–2009; 25 tracks of 22 birds in 2013–2014) from the same site shows that the earlier New Zealand departure did not achieve earlier Alaska arrival; rather, the second cohort spent eight days longer at northward staging sites in Asia, only to arrive in Alaska four days later than the first cohort. Using geolocator-derived incubation data, we explore the evidence for reproductive consequences or adaptive phenological adjustments arising from this apparent mismatch. During the period of our study, foraging conditions at the major northward staging site in the Yellow Sea have catastrophically declined. Therefore, our findings imply that habitat conditions on the migratory route can over-ride an adaptive phenology change in a long-distance migratory bird.

Jesse Conklin is an ecologist specializing in long-distance migratory shorebirds. He utilizes direct behavioral observation, remote tracking, and molecular methods to understand the ecological and evolutionary determinants of flexibility in migratory routines at the individual and population levels.



WEDS, 29 MARCH, 1655 h

Individual and population responses of long-distance migrating shorebirds to deteriorating staging habitats in the East Asian-Australasian Flyway

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In the East Asian-Australasian Flyway (EAAF), long-distance migratory shorebird populations are in steep declines, because of rapidly deteriorating habitats in their fuelling stops. In three endangered species in the EAAF: the bar-tailed godwit (a polychaete-eating specialist), and the great knot and red knot (mollusc specialists), we documented declines in yearly survival of these populations by mark-resight data of colour-ringed individuals. To investigate mechanisms of population declines, we are tracking individual movements by satellite telemetry, and measuring environmental variables at the major staging mudflats in the Chinese coast, especially prey availability by grid sampling, and coastal reclamation by satellite images.

We documented drastic changes in composition of prey communities at their major staging areas in north Yellow Sea, which triggered local responses by a shift in diet and intake rate. We also detected dispersal to other staging sites during the northward migration, which could be a plastic response to declines in local food availability. We suggest that great knots might require to make short stops before reaching their major staging areas, in anticipation of lower quality food there. This strategy reduces starvation risk upon arrival at staging sites, and allow time to adjust physiologically to consume prey of lower quality. We would examine the interplay between physiology, prey choice and migration itineraries of individuals, and explore how they together could alter staging distributions and survival of these populations..



Ying-Chi Chan graduated from the BSc Environmental Life Science at the University of Hong Kong, and obtained a MSc in Ecology and Evolution (cum laude) at the University of Groningen in The Netherlands. Her current PhD project focuses on how migratory shorebirds are impacted by, and how will they adapt to, the rapidly deteriorating habitats in China.

WEDS, 29 MARCH, 1710 h

Arctic-nesting geese speed up spring migration to compensate for warmer springs

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The Arctic region is subject to the fastest climate warming on the planet, leading to stronger phenological changes in the Arctic compared to temperate regions. This challenges birds that migrate to the Arctic for breeding to accelerate spring migration in order to avoid a mismatch between peak food abundance shortly after snowmelt and the timing of reproduction. In a 14-year study, during which snow-melt date varied with as much as a month, we demonstrate that Arctic nesting Barnacle Geese *Branta leucopsis* did not adjust the moment of departure from the wintering grounds, but were able to speed up spring migration, and thereby considerably advanced their arrival date on the breeding grounds in years with earlier snowmelt. However, they were not able to fully match arrival date with snow melt and did not advance their egg laying dates by as much as their arrival dates. We further show that in years with early snowmelt the geese reach the breeding ground in inadequate condition to initiate egg laying right after the moment of arrival, and first have to accumulate reserves at the breeding grounds. Despite migratory birds being able to speed up migration, an advancement of laying date is constrained by the time necessary to acquire body reserves necessary for laying and incubation and a fixed departure time from the wintering range. The inability of migratory birds to forecast conditions on the breeding grounds from the wintering grounds and the absence of an evolutionary response towards earlier departure may ultimately pose a challenge to arctic herbivores when snow-melt dates continue to advance.

Thomas Lameris is an ecologist focussing his research on the ability of birds to adapt to changing environments, and the interaction between local, often direct anthropogenic habitat change, and change at larger scales such as global warming. He conducts most of his research in the former Soviet Union.



WEDS, 29 MARCH, 1725 h

The big picture for pelagic shearwaters: global distribution of *Calonectris* shearwaters across the Mediterranean, Atlantic and Indian Oceans

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Conservation policies for the protection of marine biodiversity are being implemented in many international management treaties worldwide. The process of identification of Marine Protected Areas (MPAs) is often based on the spatial preference of threatened species, such as many marine predators. Multi-colony tracking studies comprising a wide geographic cover are still needed to fully understand migration patterns and wintering distributions of far-ranging marine predators. Pelagic seabirds are increasingly being used for this purpose, as they are easily tracked and can pinpoint important marine



biodiversity hotspots. Here we compile, for the first time, a massive dataset comprising year-round GLS tracks of three species of *Calonectris* shearwaters breeding along the Mediterranean and Atlantic (Macaronesian) waters. Data collected include 351 trips of Scopoli's Shearwater *C. diomedea*, 831 trips of Cory's Shearwater *C. borealis* and 103 trips of Cape Verde Shearwater *C. edwardsii* sampled respectively at 18 different Mediterranean, 8 Atlantic, and 2 Cape Verdean colonies. Combining the tracking data with colony size information, we estimated the number of shearwaters that actually exploited specific marine areas along the distribution range of these three species. After accounting for the representativeness of our dataset, we identified several areas that concentrate the majority of individuals throughout the year. These areas should be considered key foraging grounds for these species, and therefore identified as marine Important Bird Areas (mIBAs). Most of these areas coincided with major upwelling zones: some of them have already been identified as potential mIBAs, but many other areas highlighted within our study have not yet been identified as important for the conservation of seabirds or the marine environment. This study highlights the need for multi-colony approaches to understand the complexity in the year-round spatial distribution of widely distributed and far-ranging marine predators before identifying marine IBAs or establishing MPA networks.

Virginia Morera's PhD research is mainly focused in the migratory and feeding ecology of pelagic seabirds, Cory's and Scopoli's Shearwaters. Particular interests of her research are the spatial foraging distribution of breeding animals and the distributions in the wintering quarters, from a multi-colony, multi-species point of view.

THURS, 30 MARCH, 0900 h

PLENARY

Settlement decisions and migratory strategies

Tómas G. Gunnarsson^{1*}, José A. Alves^{1,2}, James Gilroy³, William J. Sutherland⁴, Böðvar Þórisson¹, Peter M. Potts⁵ & Jennifer A. Gill³

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Many long-lived vertebrates show high levels of site-fidelity (philopatry) as adults. As occupied sites vary greatly in quality, adult philopatry has profound consequences for individual fitness and demography.



Given the prevalence of adult philopatry across vertebrate taxa, the initial settlement decisions of juveniles are pivotal in shaping distributions and demographic processes across population ranges. Of particular importance are the initial settlement decisions of juveniles and any subsequent redistribution which may take place before adulthood. The relative importance of those two components has a potentially great effect on the chances of populations to adapt to environmental variability. Further understanding of these processes requires tracking of a large enough sample of individuals over long periods and at population-wide scales.

With long-term tracking of hundreds of marked Icelandic Black-tailed Godwits across the non-breeding range from their first migration to adulthood we explore the structure of the settlement process. We evaluate the evidence for flexibility or constraint in the formation of the wintering distribution of a migratory bird and the likely demographic consequences of the process.

Tómas Grétar Gunnarsson is a research professor at the University of Iceland and director of the South Iceland research Centre of UI. His research has focussed on the links between migration strategies and population processes in waders and on the effects of land-use on bird populations.

THURS, 30 MARCH, 0940 h

Survival and migratory development of Lesser Spotted Eagles *Aquila pomarina*: insights from translocation and lifelong tracking

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The mechanisms driving ontogeny of migration routines and survival of migrant birds are still largely unresolved. We studied migratory development and concomitant survival of a social soaring migrant: the Lesser Spotted Eagle (*Aquila pomarina*). Between 2004 and 2015, 79 second-hatched eaglets (Abels) that would normally be killed by their elder siblings (Cains), were removed from wild nests, reared in captivity, then released to supplement the declining German population, including 50 birds that were translocated 940 km from Latvia. In 2009, 12 of these translocated juveniles, as well as 8 juveniles and 9 adults from German nests, were tracked by satellite telemetry to determine how translocation affected the ability of birds to learn strategic migratory detours, and how migratory behaviour affected survival.

Most native German juveniles (6/8) departed along the eastern Mediterranean flyway around the same time as native adults. One translocated bird died before migrating and the remaining 11 juveniles



departed on average 6 days earlier than ad. native eagles. Five translocated eagles travelled southward, following a different innate migratory direction than native juveniles, and died in the Mediterranean region. Consequently, a smaller proportion of translocated LSEs (4/12) than native LSEs (7/8) reached Africa. Those translocated individuals that successfully migrated around the Mediterranean had departed at approximately the same time and in the same direction as native birds, suggesting they learned the route by following experienced older birds. In the future, juveniles used in such a supplementation effort should be sourced from nearby populations to ensure they can follow adults after translocation.

Unfortunately, many eagles are shot on migration or in Africa, and so few eagles survived their first year, whether they were translocated (2/12) or not (2/8). However, survivors improved migratory performance in years following their first, and had a high chance of reaching adulthood and establishing territories in or near Germany. While removing and translocating Abels helps reinforce the declining German population, illegal hunting must be stopped to ensure the species' conservation.

Wouter Vansteelant is co-founder of the Batumi Raptor Count, secretary of the Migrant Landbird Study Group, and conducted his PhD at the University of Amsterdam, investigating how weather shapes the soaring migration of Honey Buzzards. Looking for a postdoc, he currently works as a freelance migration ecologist.

THURS, 30 MARCH, 0955 h

Variation in migratory strategy within a population cannot be attributed to year, sex, or wintering location: consistency in individual routines points to ontogenetic source?

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Previous tracking studies have shown that a population of Black-tailed Godwits *Limosa limosa limosa* breeding in The Netherlands has large variation in migratory timing, duration, and destination. This variation includes wintering sites both north and south of the Sahara, departure dates for northward migration that span a two-month period, and arrival to the breeding grounds spanning a month-long period. Because life history theory predicts an optimal migration strategy – one that maximizes fitness

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and is subsequently selected for – this large variation in migratory strategy is unexpected and calls for further investigation.

We tracked adult godwits from this breeding population from 2012 to 2016. These tracking efforts yielded both geolocator (49 individuals) and satellite tracks (32 individuals), and more importantly include multiple tracks for individual birds in different years (34 individuals). These data confirm the previously described population-level variation in migratory strategy. Individuals, however, were shown to be wholly consistent in their wintering location across multiple years. Their timing of migration varied from year to year, but was insufficient to explain the observed population-level variation in timing. Furthermore, the population-level migratory variation cannot be explained by nesting success, year, nor sex, although males did consistently arrive before females on the breeding grounds. Some of the variation in migratory timing and duration is driven by wintering location; godwits wintering south of the Sahara arrive 11-14 days earlier in The Netherlands compared to birds wintering north of the Sahara. Those birds that arrived earlier also initiated their clutches 7-8 days earlier. Nonetheless, this difference in timing did not influence clutch investment or survival, or fledging success.

Individuals exhibit generally consistent migratory behaviour, but this consistency cannot be attributed to year, sex, or wintering location. Given the apparent incongruence between individual- and population-level patterns, we suggest that other mechanisms must be driving the generation of variation in godwit migratory strategy. We hypothesize that the source of the population variation in migratory strategy arises during development and that those developmental processes must result in generally consistent, life-long annual routines.

Mo Verhoeven is an avian ecologist interested in the organization of annual cycle events with a special focus on migratory birds. He currently studies the migration of Black-tailed Godwits and hopes to figure out how juvenile godwits learn their migratory routines.

THURS, 30 MARCH, 1010 h

Panarctic polygyny: nomadic movements and large-scale breeding site sampling by male pectoral sandpipers

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In species where males do not provide resources or care for offspring, competition for access to females at a breeding site is often intense with many males failing to reproduce. However, in highly mobile



species such as birds, males could increase their chances of reproduction by sampling multiple breeding areas. Little is known about such sampling behaviour and about the spatial scale at which it occurs. From 2005 to 2014, we studied a population of the polygynous Pectoral Sandpiper *Calidris melanotos* in Barrow, Alaska. We show that most individuals that arrived at a known breeding location subsequently moved through a considerable part of the entire species' breeding range, sampling many potential breeding sites over thousands of kilometers. Our data suggest that males did not have a final breeding destination after having migrated from their wintering quarters, but make nomadic movements that seem unrelated to breeding failure. We relate these observations to data from Barrow, showing that male tenure (duration of stay) depends on local opportunities to sire offspring. In conjunction with previous work on daily activity patterns, our results suggest that pectoral sandpipers are under strong selection to reduce sleep and to perform long flights between potential breeding sites. The movement patterns of male pectoral sandpipers during the breeding season imply that the population is panmictic and that local adaptation and speciation is unlikely. In line with this, comparative data suggest that subspecies are only found in socially monogamous shorebirds.

Bart Kempenaers is a behavioural ecologist with a main research focus on sexual selection and mating behaviour. He studies blue tits in Europe and shorebirds in the Arctic. He is particularly interested in understanding how variation in migration and movement strategies is linked to the mating system and to speciation.

THURS, 30 MARCH, 1025 h

Migratory birds' response to climate change: reshaping of migratory routes and flyways

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A wealth of research is devoted to migratory birds' response to climate change through geographic range shifts, as well as changes in phenology, migratory strategy, fitness, and demography. Yet, the indirect effects of climate change on optimal migratory routes and flyways, through changes in air movements, have not been addressed. However, atmospheric currents, especially the wind, play a significant role in all aspects of bird migration, and can shape migratory routes and facilitate long-distance flight, both on land and at sea. Thus, alterations in the pattern and strength of winds and other forms of air movement as a consequence of climate change can subsequently influence the quality and spatial distribution of optimal migratory routes of birds.



We tested this hypothesis by investigating impacts of climate change on optimal routes and flyways for raptors in the East Asian flyways by mid- and late century under the business-as-usual scenario of climate change (i.e. RCP 8.5). At the regional scale, we employed an ensemble of niche modelling approaches to model the migratory niche of satellite-tracked Oriental Honey-buzzards *Pernis ptilorhynchus*, using wind and convective conditions as explanatory variables, at a critical section of autumn journey from Japan to China. The model was then projected to the future conditions of wind and convective conditions. At the flyway scale, the optimal flyways for raptors in East Asia were simulated using wind conditions and compared for the present and future. The simulations were run with assumptions suitable for flight type and other characteristics of East Asian raptor migrants.

We show that the optimal routes and flyways can undergo dramatic changes until the end of the century. The response of the birds to these changes will depend on whether their phenotypic plasticity allows for making adjustments to their migratory behaviour and strategies within the necessary timeframe.

Elham Nourani is an ecologist interested in wildlife ecology and conservation, with a particular focus on migratory birds. For her PhD research, she is investigating the impacts of contemporary and future atmospheric conditions on shaping and altering the optimal flight routes of migratory birds.

THURS, 30 MARCH, 1110 h

Evolutionary consequences of non-random dispersal in a spatially structured population

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Habitat preferences can have important evolutionary consequences, and recent theoretical studies indicate that they are conditional on the underlying preference mechanism. In natural populations, different mechanisms, such as genetically-determined, natal habitat and phenotype-dependent preferences, are supposed to operate at the same time. However, their relative contribution to population differentiation remains unexplored empirically. In this study, we investigated the effect of early experience and genetic background on breeding site selection in a spatially structured population of Pied Flycatchers *Ficedula hypoleuca* in which dispersal between different habitats and subsequent reproductive performance is influenced by body size. For this, in 2006-2012 we conducted a cross-fostering experiment between an oakwood and an adjacent conifer plantation, and followed cross-fostered individuals until recruitment between 2007 and 2016. Overall, birds returned to breed in the habitat where they had been raised, indicating that habitat preferences are mostly influenced by the environment they experienced at an early age. However, nearly a third moved away from the rearing habitat and, as we previously observed in unmanipulated individuals, dispersal between habitats was



influenced by bird size. Pied flycatchers breeding in the oak and the pine forests are differentiated by body size, and recent analyses of genetic variation at microsatellite loci moreover provide evidence of a subtle genetic differentiation between the two populations, indicating that size-dependent dispersal may contribute to population structuring despite the small spatial scale. Taken together, the current and previous findings that pied flycatchers do not always settle in the habitat type in which they perform best suggest that their strong tendency to return to the natal patch regardless of their body size might lead to maladaptive settlement decisions and thus constrain the potential of phenotype-dependent dispersal to promote microgeographic adaptation.

Carlos Camacho is a biologist. He studies the potential of dispersal and habitat selection decisions to promote population differentiation at small spatial scales. He studies this in avian models, such as Pied Flycatcher *Ficedula hypoleuca* and Red-necked Nightjar *Caprimulgus ruficollis*, combining descriptive field studies and manipulative experiments in the field.

THURS, 30 MARCH, 1125 h

Linking parasitism and life-history: an energetics approach

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Many species exhibit reproductive skew with some individuals consistently more successful than others. The mechanisms underpinning this skew are often poorly understood yet can help us understand how individual variation can have consequences for population level changes. Recent work has illustrated that parasitism may play a crucial role in driving reproductive skew but may have differential impacts in different environmental conditions. We suggest that our understanding of how parasitism interacts with both intrinsic drivers and environmental conditions to determine breeding performance can be greatly improved by considering energetics, since many life-history processes can be quantified through their impacts on rates of energy use and gain. Using a novel endoscope technique to quantify parasite load and tri-axial accelerometers to estimate behaviour-specific energy expenditure in European Shags we are able to determine the energetic cost of parasitism and understand how individual responses may vary with changing environmental conditions. Here we present analyses on a population of European shags that suggest that the cost of different behaviours varies with parasite load and environmental conditions. This work provides a potential mechanism linking the energetic cost of parasitism to its role in driving reproductive skew, which may ultimately be influencing population success.



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.

THURS, 30 MARCH, 1140 h

Movement strategies of non-breeding Ravens

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The Common Raven *Corvus corax* is a species with a prolonged juvenile period. To become a breeder, sexually mature individuals have to find a partner and be able to defend a territory, which does not occur before they are 3-4 years old and, in a saturated population, may take up to 10 years or more. In this life stage ravens are often found in groups to forage and roost. These non-breeder groups can be highly vagrant, but their members may also develop preferences for certain foraging sites. The combination of large movements and temporary phases of settlement leads to a highly dynamic fission-fusion system with anthropogenic resources and night roosts as core elements. I will discuss movement strategies and individual differences in the use of resources based on the combination of presence-absence data and GPS-tracking: At a rich and permanent food source, a game park in the Eastern Alps, the presence of 185 marked ravens was monitored almost daily during five years. In addition we followed the movement of 10 non-breeders in the Alps and 12 individuals in the Massif Central in France for up to 3 years. This large and comprehensive dataset allows us to better understand movement and settlement decisions as well as population dynamics.

Matthias Loretto is a biologist with main research focus on the causes and consequences of animal movement. He recently finished his PhD project on movement ecology of ravens. In addition he worked in this field with Northern Bald Ibis and three species of dart poison frogs in the neotropical rainforest.



THURS, 30 MARCH, 1155 h

The influence of environmental predictability on individual foraging behaviour

Alice Trevail¹, Jonathan Green¹, Jonathan Sharples¹, Jeffrey Polton², John Arnould³ & Samantha Patrick¹

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Seabird tracking studies have revealed that individual foraging specialisations occur globally and across a huge range of species. However, variation in the magnitude of individual specialisation between species and populations is poorly understood, as are the underlying mechanisms of such variation. Here, we examine the importance of environmental predictability, indicative of resource stability and availability, in shaping foraging consistency in Black-legged Kittiwakes. By comparing the behaviour of individuals from multiple colonies governed by different oceanographic regimes, we will investigate whether the stability of the environment drives behaviour among individuals and consequent reproductive fitness. This study explores whether resource availability may vary the optimal foraging strategy within and between populations, providing a mechanism through which different levels of consistency may emerge. These results are particularly important as they will increase our understanding of the origins of individual behaviour and its consequences at a time of environmental change and worldwide declines in populations of marine species.

Alice Trevail is in the second year of her PhD. She has 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.

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THURS, 30 MARCH, 1205 h

Sex-specific three-dimensional foraging behaviour of Northern Gannets

Jude Lane¹, Ian Cleasby², Ewan Wakefield³, James Grecian¹ & Keith Hamer¹

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Three-dimensional analysis of foraging behaviour has revealed that Northern Gannets *Morus bassanus* fly at different heights when commuting compared to actively foraging. Although a monomorphic seabird, previous work has revealed differences in the foraging behaviour of male and female gannets. However, little is known about how gannets use elevation throughout foraging trips or whether males and females fly at different heights.

We fitted GPS and barometric pressure loggers to chick-rearing adult gannets on Bass Rock in the summers of 2015 and 2016. We analysed trips made by male and female birds. Here we present analysis of activity-specific and spatially-specific flight heights for male and female gannets.

Offshore wind turbine infrastructure has the potential to increase greatly in the North Sea within the next decade. Northern gannets forage in locations and at heights that pose a risk for potential collision with offshore wind turbines. We examine how sex-specific foraging behaviour, including elevation, may affect the potential risk wind turbines present to breeding adult gannets and how this may affect the population dynamics of the Bass Rock colony.

Jude Lane is an ecologist with a main research focus on three-dimensional tracking of seabirds. She is particularly interested in sex specific use of airspace and how environmental conditions influence these behaviours.



THURS, 30 MARCH, 1220 h

Age-related differences in the foraging behaviour of a long-lived marine predator**W. James Grecian^{1*}, Jude Lane¹ & Keith C. Hamer¹**¹School of Biology, University of Leeds, Leeds LS2 9JT, UK

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The way that animals move and interact with their environment is a fundamental, yet poorly understood process. Gaining foraging experience is crucial to long-term fitness and so many long-lived species exhibit delayed maturity with a period of learning before recruiting into the breeding population. Understanding age-related differences in movement patterns and foraging behaviours is therefore a key question. In this study, we use high-resolution GPS-loggers to track the fine-scale movements of immature and adult Northern Gannets *Morus bassanus*, and use state-switching models to examine differences in foraging behaviour. Immature and adult gannets were spatially segregated during the breeding season, immature birds spent more time away from the colony, and the departure angles and terminal locations of foraging trips were less consistent than adult birds. During foraging trips, immature gannets spent a greater proportion of time resting, and less time transiting than adult gannets; there was no difference in the proportion of time foraging. Finally, by incorporating environmental covariates into the state-switching model, we examine the links between foraging behaviour and habitat selection. The differences we detect in the at-sea behaviours of adult and immature northern gannets may arise as a result of inexperience by individuals still learning the requisite foraging skills for recruitment into breeding populations, or be the consequence of breeding imposed time constraints on adults.

James Grecian is interested in the effects that human-induced impacts such as fisheries, climate change and offshore development are having on marine ecosystems. He is particularly interested in studying spatial distributions and habitat preference in order to understand how individuals and populations may respond to these changes. You can follow him on twitter @JamesGrecian.



THURS, 30 MARCH, 1430 h

Evidence-based evaluation of *in situ* and *ex situ* management for the sustainable management of hunted Asian Houbara

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The migratory Asian Houbara Bustard *Chlamydotis macqueenii* is threatened (IUCN Vulnerable) and declining due to over-exploitation in central Asia and the Middle East, primarily through Arab falconry. Maintaining these populations is vital not only to the conservation of the species, but also if the cultural practice of falconry is to continue, which has significant geo-political and economic importance in many range states. To date, the primary intervention has been to release captive-bred Houbara, which carries significant risks to the integrity of wild populations. Using satellite telemetry we investigate the demography (productivity and survival rates) and migration strategies of both wild and released birds to develop an evidence base for sustainable management. We examine: (1) whether other *in situ* options could increase wild productivity in human-influenced semi-arid rangelands, thereby reducing the need for captive breeding (2), the demography of wild populations and (3) the relative performance and migration strategies of released birds. We use individually-based stochastic population models to investigate potential sustainable management and the contribution of captive-bred releases. We examine whether release of captive bred birds should be managed in a strategy of population reinforcement (with recruitment offsetting hunting offtake), or to provide alternative quarry for hunters, and the levels of captive release that may be required with and without other interventions.

Paul Dolman is an ornithologist and conservation ecologist who leads an inter-disciplinary research team focusing on biodiversity conservation in human-modified landscapes, using population modelling, landuse and habitat ecology, livelihood and cost-benefit analysis to underpin conservation strategy by evidence.



THURS, 30 MARCH, 1445 h

Consistency in the migratory behaviour of great shearwaters: implications for conservation**Teresa Militão^{1*}, Laila Aranda¹, Zuzana Zajková¹, Jose Manuel Reyes-González¹, Peter G Ryan² & Jacob González-Solís¹**¹ Institut de Recerca de la Biodiversitat (IRBio) i Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals, Universitat de Barcelona, Spain² Percy FitzPatrick Institute of African Ornithology, University of Cape Town, South Africa

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Governments and NGOs have engaged on declaring marine IBAs or MPAs mainly based on the at-sea distribution of seabird species. However, its efficacy still needs to be evaluated, since many pelagic habitats are neither static nor predictable and seabirds may change their use across various spatial and temporal scales. In this regard, we studied the consistency in the migratory behaviour in Great Shearwaters *Ardenna gravis* and its implications for conservation, by GLS tracking 50 individuals (80 annual trips, from 2009-2014) breeding on Gough Island. In particular, we aim to (1) identify the basic migratory phenology and areas used throughout the year; (2) evaluate the spatial and temporal consistency of these patterns over several years at population and individual levels. Most birds performed a stopover on the Patagonian shelf before departing to the N Atlantic, but some performed a stopover in the Benguela or directly headed to the N Atlantic. All birds wintered in the NW Atlantic for ~90 days and, afterwards, migrated directly to the colony or performed a pre-nuptial stopover off Patagonia. Overall, birds presented an unprecedented variability in post-nuptial migration routes across years, but a noticeable site fidelity within the stopover and non-breeding areas, giving support to the static approach of some marine IBAs, such those already proposed in the Patagonian shelf and the NW Atlantic. However, it also calls for the implementation of dynamic IBAs in areas used during migration, such as off the E coast of Brazil. Our study highlights the need to track individual seabirds over several years to understand the plasticity in movement behaviour, which may allow this species to adapt to rapid changes in the marine environment and its implications for the static approach in the definition of marine IBAs and MPAs currently applied by most countries and NGOs.

Teresa Militão focused her PhD thesis mainly in understanding the migratory ecology of seabirds using geolocation and stable isotopic data. She is interested in the implications of different migratory patterns on seabird life-history traits and population dynamics, but her interests go beyond migratory ecology, encompassing avian physiology and conservation biology.



THURS, 30 MARCH, 1500 h

Assessing the consequences of habitat loss and degradation in a long-distance migratory shorebird**Yaara Aharon-Rotman^{1,2}, Silke Bauer^{1,3} and Marcel Klaassen¹**¹ Centre for Integrative Ecology, School of Life and Environmental Sciences, Deakin University, Geelong, Australia² Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences, Haidian District, Beijing, China³ Department of Bird Migration, Swiss Ornithological Institute, Switzerland

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The conservation of migratory species represents a major challenge, as they use multiple sites, all contributing in varying degrees in sustaining high survival and reproductive success. There is particular concern for shorebirds of the East-Asian Australasian Flyway (EAAF), where declining numbers of migratory species have mostly been attributed to habitat loss along the East-Asian coast. Using geolocators to track the route and sites visited by migrants and a stochastic dynamic programming migration model, we assessed the effect of habitat degradation scenarios along the EAAF on migration behaviour, survival and reproductive success of a long-distance migrating shorebird, the Ruddy Turnstone *Arenaria interpres*. Following manipulation of habitat quality through changes in intake rate, we found that changes on the wintering (major non-breeding) ground in South Australia had the highest negative effect on reproductive success and survival. We also identified Taiwan and the Yellow Sea as sites with high importance for reproductive success. Although habitats along the East-Asian coastline are currently most threatened from a range of global change processes, we highlight the importance of conserving high-quality shorebird wintering habitat also in Australia. This may be of notable importance to trans-equatorial migratory shorebirds, which often make a long non-stop flight from their wintering grounds in order to skip low-latitude sites that typically provide little food.

Yaara Aharon-Rotman is an ecologist 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.



THURS, 30 MARCH, 1515 h

Long-term changes in the demography and conservation status of an Arctic-breeding migrant: insights from monitoring, marking, and modelling

Kevin A. Wood^{1*}, Rascha J.M. Nuijten², Julia L. Newth¹, Trinus Haitjema³, Geoff M. Hilton¹, Bart A. Nolet^{2,4} & Eileen C. Rees¹

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Many species of Arctic-breeding migrant birds are currently undergoing sustained population declines. Numbers of the northwest European population of Bewick's Swans *Cygnus columbianus bewickii* observed on the winter grounds have declined from ~29,000 birds in 1995 to <18,000 at present. It is unclear whether this decrease reflects reduced productivity, reduced survival, a range shift, or a combination of all three. Bewick's Swan numbers, productivity, and resightings of marked individuals have been monitored on the winter grounds since the 1960s; we used these data to assess changes in swan productivity and survival, and how such demographic changes may have influenced swan conservation status.

We found no evidence of a long-term change in the proportions of young Bewick's Swans in the population, or in the mean number of young per family group; these findings suggest no long-term change in Bewick's Swan productivity. Linear regression models with an information-theoretic framework indicated that fewer Bewick's Swan cygnets arrived on the winter grounds in years in which there had been more Arctic Foxes *Vulpes lagopus* and colder air temperatures on the breeding grounds.

Survival analysis using RMark indicated that inter-annual variation in estimated survival and resighting probabilities was high across our 44 year study period. Survival was higher for adults and yearlings relative to cygnets, for females compared with males, and for birds marked with leg rings compared with neck collars. Survival was poorly explained by environmental conditions (e.g. weather conditions, food resources) in the northwest European flyway, and we found limited evidence for a reduction in survival over time. Further research is needed to determine the effects that individual years of poor breeding and survival can have on population size, and the effects such years have had on the observed changes in population size.

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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.



POSTERS

Abstracts are in surname alphabetical order.

POSTER

How do nomadic waterbirds find water in the desert?

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In contrast to the seasonal, predictable migrations of birds in Europe and North America, nomadic waterbirds of Australia find ephemeral wetlands which are highly unpredictable in space and time, and separated from the birds' coastal refugia by hundreds and sometimes thousands of kilometres of inhospitable desert landscapes. How do waterbirds locate waterbodies from hundreds of kilometres away? This is an unsolved puzzle of bird navigation with implications for understanding waterbird movement globally, how birds respond to environmental change, and the role of learning and plasticity in navigational mechanisms. Using remote sensing, thermal imaging, aerial surveys from light plane, and over 110 satellite tracked black swans, black duck and banded stilts, tracked during day and night, during flooded and arid periods in Australia, we summarize findings that advance understanding of this enduring mystery of bird navigation.

Andrew T.D. Bennett is an integrative ecologist with a focus on avian sensory ecology. A major aim of his research group is revealing how nomadic waterbirds of inland arid Australia find and exploit unpredictable water.



POSTER

Foraging specialization in yellow-legged gulls: How to address an opportunistic species in conservation management?

Rahel M. Borrmann¹, Vitor H. Paiva², Filipe R. Ceia², Jaime A. Ramos², Stefan Garthe¹

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Foraging behaviour of large gulls is often characterised by their successful exploitation of a great variety of resources. In some regions this ability has led to strong population growth in the past, which is often considered to negatively affect the environment, sympatric bird species and humans. GPS-tracking and stable isotope analysis give new insights into spatial use and trophic choices of individuals, and thus should add valuable information for decisions in conservation management.

The colony of yellow-legged gulls (*Larus michahellis*) on Berlenga Island, Portugal, faced rapid growth between 1974 and 1994. After intensive management measures colony size was reduced from 44,698 breeding individuals in 1994 to 9,110 in 2016. For this study, 26 breeding individuals were equipped with GPS-loggers during the incubation period of 6 successive years (2011-2016), and from each individual blood and feather samples were taken for stable isotope analysis. We aimed at 1) identifying important foraging habitats of yellow-legged gulls, 2) analysing individual foraging strategies over short- and long-term periods, and 3) developing alternative approaches to help mitigate “gull-human” conflicts.

Results suggest that tracked birds showed individual specialization during the incubation period but were not consistent over longer time periods. Foraging strategies differed significantly between individuals using terrestrial habitats (e.g. agricultural fields or landfills), and marine habitats close to the breeding colony and off-shore. Overall, individual specialization was shown in all years despite inter-annual environmental stochasticity. Remarkably, it also continued in years of poor marine environmental conditions with probably less marine food available. Our study underlines the potential of adequate measures at the foraging trip destinations, especially at landfills within reach of the colony. By reducing the accessibility of organic waste, the ongoing positive trend in urban gull colonies in the area could be reversed at the same time.

Rahel Maren Borrmann is a PhD student in seabird ecology working with large gulls. She focusses on individual specialisation, migration strategies, and conservation management in relation to population control and offshore wind parks.



POSTER

Carry-over effects from parental investment and nonbreeding habitat quality shape annual schedules in a long-distance passerine migrant

Martins Briedis^{1*}, Miloš Krist^{1,2}, Miroslav Král¹, Christian C. Voigt³ & Peter Adamík¹

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Annual cycles of animals consist of various life history phases that are linked in a unified sequence and relationship between consecutive phases can have severe consequences on individuals' physical condition and fitness, ultimately affecting population dynamics. The complex nature of migratory animals makes it particularly difficult to identify such inter-seasonal connections. Thus, we still lack comprehensive understanding of carry-over effects operating in migratory populations across full annual cycles.

Here we link summer–winter–to–summer events in a long-distance migratory Collared Flycatchers *Ficedula albicollis* using breeding data, individual-based tracking and stable isotope signatures of winter grown tissues. We did not find compelling differences in annual schedules between individuals whose brood size was experimentally increasing or decreasing. However, annual schedules highly depended on both, the absolute parental investment (measured as a total number of fledglings) and the quality of non-breeding habitat. Individuals with higher parental investment delayed their autumn migration, had shorter non-breeding residency period and advanced spring migration compared to individuals with lower breeding effort. The magnitude of carry-over effects from parental investment weakened with progression of the annual cycle and timing of spring events, particularly onset of breeding, were more dependent on the non-breeding habitat quality. Regarding individual migration schedules we also observed a pronounced “domino effect” which weakened with increasing timespan between the consecutive parts of the annual cycle.

Our findings demonstrate the complexity and significance of links between spatially and temporally distinct phases of the annual cycles of migratory animals. Better understanding of such links is vital if we aim to stop and reverse the ongoing population declines of migratory species.

Martins Briedis is PhD student with main research focus on migration ecology of long-distance migrants in the context of the full annual cycles. He is particularly interested in the concept of migratory connectivity from a spatio-temporal viewpoint, links between different annual phases, and interactions between the environment and migrants.



POSTER

Are ‘problem’ Magpies especially responsible for nest predation?

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Predation is an important source of mortality prior to fledging in passerines and the recent decline in farmland songbirds has, at least partially, coincided with increases in populations of many generalist predators, including corvids. Although a number of literature reviews have suggested that, in general, nest predation is not limiting bird populations, some songbirds have shown a positive response to experimental predator removal. We suggest that localised variation in nest predation rates, driven by either factors extrinsic to the predators such as seasonality, spatial patterns or habitat variation, or factors intrinsic to particular ‘problem individuals’ such as social status or variation in other behavioural traits, may explain this confused picture.

We used 460 artificial nests placed in a typical agricultural environment, in a systematically balanced design, to analyse these factors. We assessed inter-individual differences in predation rates and territorial defence behaviour between colour-ringed Magpies. Magpies were the most common predators of our artificial nests (70.3% of identifiable predation events were attributed to corvids). Artificial nests placed in open hedgerows at the start (April) and end (July) of the breeding season were more heavily predated but the most significant predictor of nest predation was the geographical location of the nests. Specific nest locations were repeatedly highly predated, independent of variation in their habitat and the stage of the breeding season. Camera observations indicated that particular territorial individuals predated specific locations, with some ‘problem individuals’ engaged in disproportionately high predation levels. These more predatory individuals were also likely to engage in aggressive territory defence when presented with a dummy territorial intrusion. Predator removal will only be effective if these ‘problem individuals’ responsible for most predation are removed.

Lucy Capstick is a PhD student at the University of Exeter. Her research is mainly based on the ecology of corvids in rural environments with a particular focus on their predatory impact on farmland songbirds.



POSTER

Seabirds in the Space! Link your tracking data with environmental variables in a single click

Ana Carneiro^{1*} & Maria Dias¹

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Understanding the environmental conditions that affect the distribution of species is an important step to help authorities make real-time decisions to protect selected species and to inform dynamic management scenarios. Studies that combine tracking data with remotely sensed environmental data in habitat models have provided key insights. Habitat modelling techniques and the use of remotely sensed environmental data, however, can be challenging due to computational and memory complexities.

EO4wildlife project aims to design and develop an open service platform and interoperable toolbox to process geospatial environmental simulations using Sentinel Earth Observation data that are intelligently combined with other observation sources. The platform will offer high level services that can be accessed by scientists to perform their respective research. Services will be based on dedicated scenarios that were built based on the interest of different scientific communities: seabirds, sea turtles, marine mammals, and pelagic fishes. BirdLife international has been working on the seabird scenario to facilitate the linkage between the seabird tracking data and environmental variables.

The general objective of this scenario is to be able to predict distribution of species of seabirds using environmental data in order to identify and monitor important bird areas, and to develop effective management frameworks taking into consideration threats and pressure. One result from the EO4wildlife project will be to be interoperable with the Seabird Tracking Database (<http://www.seabirdtracking.org/>) to allow the scientists to manipulate their own tracking data hosted by this platform.

Ana Bertoldi Carneiro is a Marine Science Officer for BirdLife International's Marine Programme, based in the Science, Policy and Information Department at the Global Secretariat in Cambridge, U.K. She joined BirdLife in 2016 after finishing her PhD at the Department of Zoology, University of Cambridge, and British Antarctic Survey. Her main interests focus on spatial ecology and distribution of seabirds, in particular, to identify the key ecological drivers and enhance their conservation.



POSTER

Multi-year GPS tracking and stable isotope analysis reveals the nature of sexual segregation in a medium-ranging seabird**Bethany Clark¹, Freydís Vigfúsdóttir², Richard Sherley¹ & Stephen Votier¹**¹ Environment and Sustainability Institute, University of Exeter, Penryn Campus, Penryn, Cornwall, UK, TR10 9FE² Icelandic Institute of Natural History, 6-8, Urriðaholtsstræti, 210 Garðabær, Iceland

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Sex-specific foraging behaviour is common across many animal taxa, and has substantial ecological and evolutionary consequences both in terms of spatial separation and behaviour differences in prey choice. Sexual segregation may vary over time, but this has been rarely examined in seabirds, with few studies reporting data from periods longer than one-to-three breeding seasons. We investigate sexual segregation for a medium-ranging marine predator, the Northern Gannet *Morus bassanus*, using an eight-year GPS tracking and a seven-year stable isotope dataset. GPS tracking data can provide high-resolution data on the space-use of foraging seabirds, and stable isotope analysis can detect differences in diet, but it is difficult to separate isotopic differences caused by spatial segregation and prey choice. Previous studies have found both spatial and isotopic segregation for Bass Rock gannets, and spatial segregation for Grassholm (data from only one year). Firstly, we find that short term data may not be representative as spatial segregation reported in Grassholm gannets in 2006 was not maintained in 2010-2016. Secondly, we find isotopic segregation and differing trip lengths even without spatial separation, indicating that male and female gannets at Grassholm are still selecting different prey within the same spatial area. An explanation could be that male gannets are reliant on scavenging from fishing vessels, which could have population-level consequences in response to changes in fisheries policy. Overall, our findings show that the sexually-segregated behaviour of a species cannot be categorised by studying single colonies or a snapshot in time.

Bethany Clark is a PhD student with Stephen Votier who studies gannet foraging behaviour using bio-logging technology. She is interested in movement ecology particularly using multiple loggers to track birds in three dimensions by recording altitude and tri-axial acceleration.



POSTER

Individual migration timings and routes of Bee-eaters breeding in the south of the range**Joana Costa^{1,*}, Afonso Rocha², Miguel Araújo², Steffen Hahn³ & José Alves^{1,4}**¹ CESAM, Dep. Biology, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal² MARE, Marine and Environmental Sciences Centre, Dept of Life Sciences, Univ. of Coimbra, Portugal³ Department Bird Migration, Swiss Ornithological Institute, Seerose 1, CH-6204 Sempach, Switzerland⁴ South Iceland Research Centre, University of Iceland, FjölheimarIS-800 Selfoss, Iceland

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Across Europe, population declines are being reported in a wide range of Afro-Palearctic migrants. The causes of these declines remain unclear because of their wide distribution ranges and the large number of locations which individuals use. The vulnerability of these species appears to be higher in long-distance (particularly trans-Saharan) than short-distance (within-Europe/N Africa) migrants, suggesting that population declines are being driven by changes during the non-breeding season. Climate and land use changes are two of the factors that might be affecting long-distance migrants, possibly with varying intensities over different phases of their annual-cycle. Therefore, disentangling the mechanisms that affect these species in order to inform conservation requires an understanding of their migratory schedule and routes, as well as, the location of stopover sites and nonbreeding areas.

The European bee-eater *Merops apiaster* is an Afro-Palearctic migrant that breeds in temperate regions and overwinters at tropical latitudes. Despite the species' relatively well known breeding area, little is currently known about their spatio-temporal distribution throughout the annual cycle. We used geolocators to investigate migratory patterns of bee-eaters breeding at the southern part of its breeding range. Four bee-eaters were tracked from two breeding colonies in Portugal, to their nonbreeding areas in Africa. Here we present the first results from this study describing their migratory timings, routes and stop-over and wintering locations.

Joana Costa is an ecologist with a research interests on bird migration and food webs. She is currently conducting a PhD at the University of Aveiro and SOI on migratory strategies and demographic processes of an Afro-Palearctic migrant, the European Bee-eater.



POSTER

Tracking reveals long-range foraging by Storm Petrels off the Irish Atlantic coast

Jodie Crane¹, Adam Kane¹ & John Quinn¹

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GPS tracking of seabirds provides unprecedented insights into their behaviour and ecology, especially for those species that are difficult to observe at sea. Tracking has enabled key foraging sites to be identified, and high resolution GPS data represents a significant improvement on locations inferred through traditional boat or land-based surveys. Initially, the size of the GPS tags restricted which species could be effectively tracked, however, continued miniaturisation now presents opportunities to study even the smallest of seabirds at a high resolution, and thus further inform conservation policy and initiatives. We used miniature (< 1 gram) GPS tags to determine at-sea foraging areas for European Storm Petrels *Hydrobates pelagicus* breeding in a colony off the Atlantic coast of Ireland, a small and difficult to observe seabird species whose at-sea behaviour was hitherto largely unknown. Storm petrels were found to travel long distances (up to 336km offshore), much further than previously estimated. We identified feeding areas by fitting hidden Markov models to the tracking data, and by using remote sensing data from 'Movebank', these areas were found to correspond with oceanic features, suggesting that upwellings may be an important foraging environment. Our study represents one of the first attempts to characterise European storm petrel movements at sea, and is an example of the increasing sophistication of miniature tags as applied to seabird research.

Jodie Crane is a behavioural ecologist with primary interests in avian bioacoustics and seabird ecology. After completing a PhD on avian communication in 2014, Jodie worked on seabird projects on Skomer, Fair Isle, and Ireland. She currently works on a project investigating the evolutionary ecology of cognition in Great Tits.



POSTER

The role of demographic parameters in range change in an Afro-Palearctic migrant

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Understanding the mechanisms by which species change their range will help us predict species' response to environmental change. Eurasian Reed Warbler *Acrocephalus scirpaceus* is an Afro-Palearctic migrant which has recently expanded its range in the UK, but the underlying demographic mechanisms are unknown.

In our study we aim to establish the individual contribution of dispersal, productivity and survival to UK range change in Eurasian reed warbler. Using hierarchical models, we estimate demographic parameters and their variation in space and time from some of the most comprehensive datasets on survival, breeding success, abundance and distribution in the world. We show that the trend in survival over time is positive in the colonised area and zero or slightly negative in the core area. This suggests that edge-ward improvements in survival may underlie the range expansion in this species. The role of productivity and dispersal in the range change are less clear, but interesting spatial dynamics are evident in all of the demographic parameters.

Jacob Davies is a PhD student in the Department of Biology at the University of York. He is interested in the demographic processes underlying population and range dynamics. Specifically, his research focusses on the role of dispersal in range change in birds.



POSTER

Metapopulation dynamics of papyrus-restricted passerines in East Africa**Lynda Donaldson^{1*}, Robert J Wilson², Jon Bennie³, Ilya MD Maclean¹**¹ Environment & Sustainability Institute, University of Exeter, Penryn Campus, Cornwall TR10 9FE² College of Life and Environmental Science, University of Exeter, Exeter EX4 4PS³ Department of Geography, University of Exeter, Penryn Campus, Cornwall TR10 9FE

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Papyrus *Cyperus papyrus* swamps in sub-Saharan Africa are severely threatened by habitat loss from drainage and encroachment for agriculture. Within East Africa, these swamps host a suite of endemic bird species, including the globally threatened Papyrus Yellow Warbler *Chloropeta gracilirostris*. Current conservation initiatives to protect these species, such as Ramsar and Important Bird and Biodiversity Areas (IBA's), are largely site-based and focus on sites that host high numbers of birds. However, wetlands are naturally fragmented habitats and form part of larger networks of sites. While periodic extinctions of local populations occur within smaller swamps, movement between sites enables recolonization from nearby swamps. Thus, the persistence of the population as a whole is dependent on the spatial configuration of habitats, which does not form part of current conservation planning. Using occupancy data collected from a network of swamps in SW Uganda, we create metapopulation models for papyrus endemic birds and investigate the importance of swamp networks for sustaining viable populations of these species. We model a variety of scenarios to establish which swamps are most important for populations of these birds, determine how viable existing protected swamps are in their own right, and ultimately identify where the limited conservation resources in the region should be channelled. This work highlights how we can best prioritise our efforts to secure the long-term population viability of papyrus endemic passerines, helping inform strategic conservation planning within fragmented landscapes.

Lynda Donaldson is a PhD student researching the conservation and ecology of wetland birds in Africa, focusing on papyrus swamps in Uganda. She is interested in finding practical solutions to issues associated with landscape-scale conservation, particularly in tropical regions where a balance between biodiversity conservation and rural livelihoods is key.



POSTER

How social are ornithologists?

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The publication of science is surely meaningless if it isn't read. Gone are the days when researchers would publish and hope that someone finds, reads and cites their research. Scientists can now promote their own work and societies and journals can publicise their authors' papers, and this is made all the easier with the advancement of online and mobile technologies and social tools for engagement.

Our poster, and IBIS Viewpoint article of the same title (Dudley & Smart, 2016, IBIS, DOI: 10.1111/ibi.12403, explains the growing use of social media within ornithology, how the BOU promotes ornithology using social media, how social media now contributes to research, citizen science projects and published articles' Altmetric Attention Scores, and how the RSPB Centre for Conservation Science has used Altmetric data to improve their science communication and drive the Altmetric Attention Scores of their published research.

Steve Dudley is responsible for delivering many of the BOU's activities including social media and communications. **Jen Smart** is a conservation scientist at the RSPB Centre for Conservation Science and part of their team running their @RSPBScience Twitter account.

POSTER

A method to estimate field metabolic rate in seabirds

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For free-ranging animals, field metabolic rate (FMR) is the total sum of energy metabolised over a specified period of time. It is a key driver of ecological processes at every biological level, strongly influencing community interactions, individual survival and population demography. We wanted to identify the large-scale influences of FMR in seabirds and create a model, based on readily available ecological and physiological parameters, which could be used to estimate FMR for previously unstudied seabird species. To do this we performed a phylogenetically controlled meta-analysis of data from 53



studies of energetics in 42 species of seabird. We found that FMR varied greatly between species and was positively influenced by body mass and colony latitude. However it was not significantly impacted by the number of breeding pairs at the colony or by phylogenetic non-independence. FMR increased throughout the breeding season from incubation to brood to crèche and lower rates were found in species with larger average brood sizes. Based on these results, we present a series of Bayesian phylogenetic mixed-effect models which can be utilised, alongside easily attainable ecological and physiological parameters, in order to make predictions of FMR for seabird species where this has not previously been calculated. We hope that these models will be utilised in order to complement behavioural studies and increase understanding of the influence of energetic demands on the role of seabirds as driving components of marine systems.

Ruth Dunn is a PhD student interested in researching the influences of anthropogenic impacts on the marine environment. She is particularly passionate about the study of seabirds due to their role as conspicuous bioindicators and is currently studying the behaviour, energetics and demography of 3 UK species.

POSTER

Insights into migrant arrival phenology from between year variation in arrival distributions

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Concerns over population declines in long distant migrants associated with climate change are stimulating intense interest in arrival phenology, aimed at determining the extent to which migrants may be responding to recent advancement in the onset of spring. Open-access internet platforms such as the UK BirdTrack survey provide a new data source to support these studies. These recently established approaches provide data for a relatively short period only, apparently limiting their utility in the direct study of longer term trends. However, they may provide an effective means to study year-to-year variation in arrival timing which can provide some insight into the factors that affect arrival timing and longer term trends.

Using BirdTrack survey data, the arrival distribution characteristics of Whitethroat have been determined at the UK regional level, demonstrating a substantial between year variation. A sixteen day difference has been determined between the earliest and latest mean arrival dates over a fifteen year period. The widths of the distributions have also been found to vary considerably, from a minimum standard deviation of 3.5 days to a maximum of 9.5 days. These variations appear to be largely attributable to



variable weather impacts on the progress of migration, indicating that amelioration of weather conditions along migration routes may facilitate the progress of migration and be a significant factor determining longer term arrival advancement trends. These observations have potentially significant implications for the adaptive responses of migrants to climate change

Mark Eddowes is an independent researcher with a particular interest in long-distant migrant arrival phenology developed through volunteer involvement in ornithology. He has considerable previous experience in physical science research and currently works in technical consultancy.

POSTER

Do Nightjars visit takeaway restaurants? Foraging behaviour of Nightjars mapped using GPS-loggers

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European Nightjars *Caprimulgus europaeus* are crepuscular insectivorous birds that breed in semi-natural habitats, closely associated to sandy soils. In Flanders, breeding areas of nightjars are mainly found in heathland habitats. Despite many local conservation programs, current population sizes are believed to be small compared with 19th century estimates, a decline resulting from severe habitat loss since the late 19th century.

Management of foraging habitats, such as extensively-grazed farmlands and wet meadows, are not included in current conservation programs. In order to improve the efficacy of conservation measurements, a better understanding of nightjars' foraging ecology is required. To investigate why foraging distances vary between individuals we collected information on foraging behaviour of over 60 nightjars tagged with VHF-tags and another 30 tracked using nano-GPS-loggers in three populations. We 1) identified the influence of habitat configuration and composition on individual's foraging distance, 2) calculated time of absence of adults on their nesting site using temperature loggers and 3) compared food availability between breeding and foraging habitats.

We found that food availability is significantly higher in foraging habitats compared to breeding habitats. Furthermore, a lower percentage of foraging habitat in proximity of a nightjar's nesting site and a clustered landscape (i.e. when different functional habitat types are clustered together) cause an



increase in foraging distance and foraging time. The duration of these foraging trips is related to temperature and time after sundown.

Using remote tracking technologies on a light weight (>100g) birds, we collected more detailed information on nightjars' habitat use. We are now able to identify where, why and when individuals forage. This information will help us to assess the impact of landscape configuration on population processes and eventually facilitate the conservation of nightjars via an optimized implementation and protection of foraging habitats in their conservation plans.

Ruben Evens is a biologist with a main research focus on foraging ecology, migration 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 and its economic implications.

POSTER

Effects of food supplementation and sex on patterns of natal dispersal in the Little Owl

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Natal dispersal is pivotal in linking spatial and demographic patterns by redistributing individuals within or among populations. Dispersal is an obligate ontogenetic stage in many species, though dispersal is plastic, multi-causal, and context-dependent. Dispersal timing, distance and path can affect the success of the process. Limited knowledge of the drivers and patterns of dispersal remains a major gap in the understanding of long-term dynamics of spatially-structured little owl (*Athene noctua*) populations.

We radio-tracked 150 juvenile Little Owls *Athene noctua* during dispersal. To disentangle effects on dispersal of ontogeny from environment during growth, we supplemented food during the nestling period to 34/29 females/males, and tracked 52/35 unsupplemented females/males. We analysed net displacement using a Generalized Additive Model (GAM), we defined movement modes using a hidden Markov model (HMM), and we analysed habitat use during different dispersal phases and movement modes.

Onset of dispersal was highly synchronised, and did not differ between sexes or treatments. Fledglings took their first forays out of the natal range at 94.2 ± 1.6 days old, and started dispersing at 122.2 ± 4.1



days old. Females dispersed further (7.69 ± 0.80 km) than males (5.74 ± 0.83 km). GAM showed that males in the control group dispersed somewhat faster than in the treatment group. Juveniles settled at 179.5 ± 6.4 days old. During all phases of dispersal, juvenile owls used optimal habitats, with no evidence of increased use of suboptimal habitats.

As expected in birds, females dispersed further than males. Food supplementation did not affect timing of dispersal, sex-specific net displacement, or habitat use, but contributed to subtle differences in the duration and speed of transfer in males. We conclude that dispersal in little owls is mainly determined by intrinsic factors (sex, ontogeny), but that environmental conditions (e.g. food supply) during growth can modulate some dispersal processes.

Julien Fattebert is a biologist with a main research focus on animal spatial and landscape ecology, and wildlife conservation. He is particularly interested in dispersal ecology, and in integrating movement ecology and habitat selection to landscape connectivity modelling to inform applied conservation strategies.

POSTER

Comparing Avian Community Composition in Seventeen Oxfordshire Woodlands with Varying Woodland Area

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Deforestation has reduced woodland cover in the UK to just 11% and much of this woodland now consists of relatively small and isolated fragments. Fragmentation poses serious problems for woodland-dependent birds. Not only does it reduce the area of available habitat, but increased isolation can also limit movement between fragments, leaving populations isolated and potentially vulnerable to local extinctions. The degree of movement can be strongly affected by surrounding land-use, with open agricultural environments representing significant barriers for some species. Furthermore, individuals which do reach an isolated woodland may not choose to settle there if the woodland is below the minimum area required to support a breeding pair. On the other hand, small woodlands may be more attractive to non-woodland-dependent species, which may utilise woodland edge for nesting and foraging. This suggests, not only should smaller woodlands have fewer species, but species composition should also change with area, due to loss of strongly woodland-dependent species and an increase in edge-species.



We investigated avian community composition in a sample of 17 Oxfordshire woodlands with area $0.2 < A < 120$ ha. Three dawn area searches were conducted in each woodland during April/May 2016, recording encounter rate data for each species. Woodland comparability was assessed with habitat surveys and completeness assessed with species accumulation curves. Woodlands with $A < 3.6$ ha had significantly lower species richness. 60% of woodland-dependent species analysed showed a significant positive correlation of encounter rate with area, while $>60\%$ of non-woodland-dependents were insensitive to area or showed a negative correlation. Non-woodland-dependents therefore constituted a larger fraction of encounters in smaller woodlands. We conclude larger woodlands provide better conditions for many woodland-dependents (however provision of specific internal habitat types is necessary for some species), while internal habitat variety can increase the attractiveness of mid-sized woodlands ($4 < A < 25$ ha) to non-woodland-dependents which may also be of conservation concern.

Emma Gardner previously worked as an astrophysicist, specialising in modelling spatial and temporal variability, and currently works for the Environmental Change Institute at Oxford University. She is interested in applying her analytic and computer modelling skills to research that contributes towards species and habitat conservation.

POSTER

Breeding and dispersal of Eurasian Jackdaws *Corvus monedula* within a network of man-made colonies

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Given the clumped distribution of nests and the higher detection probability of adults, colonies offer unique opportunities to estimate demographic parameters. Colonies built in man-made structures provide additional opportunities to investigate settlement patterns, allowing thus to link habitat selection decisions with population dynamics. Here, we ask how habitat selection process affects population dynamics in Eurasian Jackdaws *Corvus monedula* breeding in a network of man-made structures built along a gradient of agriculture landscape heterogeneity in Catalonia (NE Spain). By combining long-term information on the settlement process with data on breeding success and dispersal, we analyse the interactions between population parameters and farmland landscape structure.



David Giralt is a biologist with a main research focus on bird ecology, conservation and management in agro-forestry systems with a specific emphasis on farmland and steppe-land habitats. He worked on avian response to current major biodiversity drivers, such as agricultural intensification, using different approaches ranging from habitat selection and breeding biology to population viability analysis of endangered species.

POSTER

Effects of avian tracking devices on marked individuals – a meta analysis.

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Since radio transmitters were first introduced to field ornithology, the prospect of obtaining high quality data on a bird's location or activities, particularly when remote from the observer, has driven the rapid development of tracking devices. The deployment of a wide range of different devices has enabled many hitherto unanswered questions to be successfully addressed. Topics covered range from long-distance migration to fine-scale habitat use and from the dynamics of populations to the adaptive value of individual behaviour. While researchers make considerable efforts to minimize the effects of these devices on their study animals, and hence on their research findings, there is now a substantial body of published evidence that birds may experience a greater energy demand, or behaviour modification associated with the mass or dimensions of an attached device.

In order to assess the scale of such effects and to identify the circumstances in which they may arise we constructed analyses of a database containing key information from over 3,000 references reporting tracking studies from throughout the world.

We report on the incidence of reporting of different types of effects, and explore the relationships between the frequency and magnitude of effects and a suite of key predictor variables including device type, attachment method, mass of the device in relation to body weight and taxonomic group. We also examine how these relationships have changed over time, as technologies and methodologies have developed. Tracking technologies continue to advance very rapidly, opening opportunities to address new questions and to track species for which earlier technologies were unsuitable. While the details of the risks and benefits (generally for conservation at the population level) for individual species are changing as the technologies evolve our broad approach retains high relevance to optimizing the trade-off between welfare and information gain.



Graham Geen is a volunteer researcher working at the BTO. He is particularly interested in supporting the continued and expanding use of novel technology marks in order to obtain vital information, in particular on movement ecology, and thereby enabling international avian conservation efforts to be appropriately directed.

POSTER

Migration of the easternmost breeding population of Eleonora's falcon *Falco eleonora*

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Recent studies have used a variety of telemetry methods to track avian migration. Much of this has focused on identifying wintering grounds of birds, including raptors. Such work includes studies of migration routes of Eleonora's Falcon, with routes identified using satellite telemetry suggested they avoid ecological barriers. But little is known about whether certain habitats are preferred during migration routes and in particular for stopovers.

Cyprus hosts the easternmost breeding population of Eleonora's falcon with about 130 pairs. Fourteen transmitters were attached on individuals from Akrotiri colony, and their movements monitored since 2013. The species overwinters almost exclusively in Madagascar, thus travelling more than 6000 km in each migration season. For the first time we used GPS/GSM transmitters on Eleonora's falcon, to accurately monitor migration routes, allowing us to map in high spatial and temporal detail their movements.

We found that birds from the Cypriot population follow an approximate closest distance route during autumn migration, with short stopovers for refueling and roosting. However, we found a preference for migration through more vegetated areas according to remotely sensed data from the MODIS satellite, based on significantly higher values for Enhanced Vegetation Index (EVI) and percent tree cover (Vegetation Continuous Field) than at random locations within the area encompassed by migratory paths of birds. This finding suggests falcons migrate through habitats that give them better feeding opportunities during stopovers. During spring migration the total distance travelled back to Cyprus is even shorter and takes fewer days, at higher average speeds. They do not travel over habitat with higher EVI or tree cover in spring than random, appearing to return as quickly as possible back to the breeding grounds. Overall individuals fly greater distances during daylight hours, though faster speeds have been recorded during the night when they fly solely for migratory purposes.



Thomas G. Hadjikyriakou is a PhD Candidate at the Behavioural Ecology and Evolution Lab of the University of Cyprus. His research is focusing on the ecology of Eleonora's Falcon *Falco eleonora* breeding population in Cyprus. He is particularly interested on breeding success, migration routes and wintering habitats of the species.

POSTER

Personality, foraging behaviour and fitness consequences in Antarctic petrels

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Studies have highlighted the importance of both individual foraging specialisations in seabirds and consistent individual behavioural differences, or “personalities”, in driving individual heterogeneity in fitness. Life-history strategies have been shown to relate to personality differences at the species- and the individual-level. However, most empirical research focusses on short-lived model systems, despite the prediction that life-history trade-offs are expected to be more detectable and susceptible to environmental change in long lived species. As long lived species with delayed senescence, seabirds are ideal models to improve our understanding of the relationship between life-history and personality, but to date have received little attention. Here we use novel object tests to measure consistent individual variation in boldness, a personality trait previously demonstrated as heritable and repeatable in seabirds. Using the Antarctic Petrel *Thalassoica antarctica* as model system, we examine how personality may drive individual differences in foraging behaviour in response to environmental conditions, and the associated consequences for individual reproduction. By comparing data on repeated foraging trips and multiple personality tests over the breeding season, we will be able to examine behavioural plasticity, responses to sea-ice shifts and improve our understanding of how these selection pressures may act on behavioural traits, with implications for conservation of marine predators.

Stephanie Harris research interests are in behavioural ecology and studying how behaviour and environment interact to determine individual reproductive success. I am in the first year of my PhD at the University of Liverpool.



POSTER

Investigating the ecology of black guillemots in relation to marine renewable energy and marine protected areas**Daniel Johnston¹, Robert W. Furness², Alex Robbins³, Mark Taggart¹ & Elizabeth Masden¹**¹ Environmental Research Institute, North Highland College, University of the Highlands and Islands, Thurso, KW14 7EE² MacArthur Green Ltd, 95 Woodside Road, Glasgow, G20 6NT, UK³ Scottish Natural Heritage, Battleby, Redgorton, Perth, PH1 3EW

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In Scotland, Black Guillemots *Cephus grylle* are thought to specialize in an inshore, demersal, piscivorous diet, and have been seen to associate with tidal currents while undertaking foraging dives. Individuals have also been recorded to dive to depths at which tidal turbines will likely operate. These behaviours make them potentially vulnerable to planned tidal-stream marine renewable energy developments. However, unlike other diving seabirds, the black guillemot is relatively understudied. Therefore further research is needed to understand the spatial and temporal aspects of foraging behaviour and habitat use, as the potential effects of tidal turbines may include collision risk, habitat modification, and changes in prey distribution.

Furthermore, in 2014, six Marine Protected Areas (MPA) were allocated in Scotland specifically for black guillemots, recognising the importance of their conservation. Investigating the foraging movements of black guillemots will help to assess the effectiveness of such conservation measures.

17 breeding adult Black Guillemots were GPS tracked in June 2016 on the islands of Stroma and North Ronaldsay. The average maximum foraging range was 10.17 km (SD=6.26). A maximum distance of 26.77km, was recorded from an individual repeatedly travelling from Stroma to Scapa Flow, Orkney. Tracks display foraging site preference, and are the farthest recorded foraging distances of breeding black guillemots. Tracks also associated with tidally dynamic areas within which tidal energy projects are planned. To provide an insight into how foraging tracks relate to chick diet, a mixture of direct observations and camera traps were used to identify prey items delivered, and feeding frequency at monitored nests. Cameras were placed at nest entrances of both handled and unhandled birds. The traps also picked up predator presence, kleptoparasitism, and even fledging chicks. Here we will present results from the 2016 field season, relating GPS tracks to tidal currents, benthic habitat, and prey species.

Daniel Johnston is a PhD student with an interest in seabird foraging behaviour and marine ecology. His research focuses on black guillemots with field sites in Scotland. He has a background in field work with the British Antarctic Survey and Farallon Islands Bird Observatory.



POSTER

Spatial and temporal philopatry of Red-throated Divers *Gavia stellata* during migration and wintering

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The Red-throated Diver *Gavia stellata* is a strictly protected migratory species breeding primarily in the arctic regions and wintering in temperate coastal waters of the northern hemisphere. It is the most widely distributed member of the diver/loon family. In Europe, the eastern part of the North Sea is known to be an important wintering area for this species with high diver abundances in late winter and spring. However, the movement ecology of this species is still unclear. A better understanding of space utilisation in terms of site fidelity and timing of movements is highly needed to avoid conflicts with or assess impacts of human activities.

We successfully tracked 27 Red-throated Divers, tagged with satellite transmitters in the German North Sea between February and April of 2015 and 2016, throughout their annual cycle. In this study we aimed to answer the following question: Do birds consistently utilise the same wintering, staging, breeding and moulting sites, in both time and space? We used home range analyses to define areas of high utilisation, during different stages along the annual cycle, and we further calculated site fidelity and compared the timing of utilisation within and between years. The tagged Red-throated Divers displayed generally a high site fidelity, indicating that these birds largely utilise the same migration routes as well as the same staging, breeding and to some extent the same wintering areas year after year. Similarity in temporal patterns was also evident. Faithful movement patterns within wintering sites and along their way to breeding areas and back revealed important habitats and connectivity between sites used during wintering and migration.

The high site fidelity of this sensitive species highlights the importance of minimising anthropogenic disturbances within areas highly used by divers.

Birgit Kleinschmidt is a biologist with a main research focus on ecology and conservation. She is particularly interested in ecosystems and species-habitat interactions. She is doing her PhD on movement ecology of Red-throated Divers.



POSTER

Use of marine resources at the breeding grounds by Long-tailed Skuas *Stercorarius longicaudus*

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Long-tailed Skuas *Stercorarius longicaudus* are site faithful seabirds, which often depend on rodents for breeding. Given the importance of breeding territories, skuas are expected to defend them for as long as possible, even in non-breeding years. How long they can stay is probably determined by how well they can maintain their body condition, which is often set by rodent availability. Alternatively, skuas may use lipid-rich marine food, but not all breeding populations have access to these resources. Therefore, we hypothesize that Long-tailed Skuas prolong their stay at the breeding site only when marine resources are accessible.

We test this by using wet/dry information from geolocators deployed on skuas in Greenland, Svalbard and Sweden, i.e. in study areas that differ in terms of access to the marine environment. We found that birds from areas where breeding relies on rodents only used marine resources in non-breeding years. Birds with no access to rodents used marine resources during the entire breeding season, in particular during the chick rearing period and failed breeding seasons. Timing of autumn migration was also affected by marine resource: coastal populations had relatively constant departure timing, whereas inland populations departed >1 month earlier in non-breeding years.



Jannie Fries Linnebjerg is a researcher within the field of movement ecology of seabirds. She is particularly interested in the daily non-breeding movement behavior of diving seabirds with emphasis on survival strategies and decision making.

POSTER

The role of small rodents in predation of Wood Warbler nests

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On the breeding grounds, the Wood Warbler *Phylloscopus sibilatrix* shows behaviour typical of a nomadic species: site tenacity is low and annual fluctuations in breeding numbers exceed the variation in local reproduction and survival of birds. As sudden declines in Wood Warbler breeding numbers coincide with outbreaks of small rodents, and nest losses (mostly due to predation) are higher in these outbreak years, birds seem to avoid breeding in areas with many small rodents due to nest safety. It was hypothesised that the decision of birds to settle and reproduce can be driven by the direct and/or indirect predation threat posed by small rodents on these ground-nesting birds. It was presumed that small rodents may be important nest predators of Wood Warblers, but their high abundance may also attract other mammalian predators which hunt rodents, leading to higher nest losses. Here, we show results for the identity of nest predators of Wood Warblers in the primeval part of the Białowieża Forest (Poland). We present the foraging activity of potential and actual nest predators recorded by cameras installed at Wood Warbler nests to assess the impact on the birds of small rodents, mammalian carnivores and other species.

Marta Maziarz is a forest biologist with a research focus on animal ecology and behaviour. The main topic of her studies involves the ecology and evolution of nest site selection by cavity- and open-nesting birds.



POSTER

Year-round satellite tracking of Amur Falcon *Falco amurensis* reveals the longest migration of any raptor species across the open sea

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The title for undertaking the most arduous of all raptor migrations, belongs certainly to the Amur Falcon, which is a complete transcontinental, transequatorial, long-distance flocking migrant. The principal breeding (mainly NE China) and wintering (mainly S. Africa) ranges are separated by both 70° of latitude and longitude.

Details of the species' spring migration route have been almost completely unknown. It was assumed that Amur falcons follow an elliptical course, and that spring migration takes the birds northwest of their southbound (autumn) route, journeying overland from southern Africa, north to the Horn of Africa and from there northwest into the Arabian Peninsula en route to Iran, Afghanistan, and Pakistan.

Since 2010 we have tracked 10 adult falcons fitted with 5 gram solar-powered satellite transmitters. Contrary to previous assumptions, the spring migration is not predominantly overland, but is a non-stop flight across the Indian Ocean from Somalia to India, covering 2,500 - 3,100 km of open water. From India, falcons fly around the Himalayas, and on to the breeding grounds. The assumption of an ocean crossing in autumn is confirmed by our data. Eight ocean crossings by one female were recorded during 2010-2014, establishing that the migration of Amur Falcon regularly includes the longest (2,400 - 3,150 km) open-sea crossing of any bird of prey species. In total, both southbound and northbound migrations lasted about two months, and the distance as measured by the paths used by the birds between the breeding grounds and the wintering areas was about 14,600 kilometres.

The annual cycle of Amur Falcon takes advantage of existing ecological and environmental conditions. Monsoons provide tailwinds for migrating falcons in both directions, and the late breeding of the falcons allows them to breed in Magpie *Pica pica* nests, from which the young have already fledged.

Bernd Meyburg is Chair of the World Working Group on Birds of Prey (WWGBP) and head of the BirdLife Germany (NABU) Federal Working Group on Bird of Prey Protection. He has satellite-tracked some 16 raptor species in Europe, Africa and Arabia since 1992.



POSTER

Measurement of the flight height of the Lesser Spotted Eagle *Aquila pomarina* in its breeding grounds using GSM/GPS telemetry in order to estimate the risk of collision with wind power plants and flying objects

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Wind turbines pose a collision risk to flying birds, and can currently be up to at least 210 m in height (highest point). Determining the flight height of birds is critical to accurately estimating the collision risk at the turbines, including that of species of conservation concern like Lesser Spotted Eagle. Flight height data can also be used to understand the risk of bird strike to commercial and military aircraft, events that are costly and can result in loss of human life.

In 2012 and 2013 we fitted five adult Lesser Spotted Eagles with prototypes of a 25g GSM/GPS transmitter that accurately record flight altitude (manufacturer Microwave Telemetry, Inc., USA). The flight height of each bird was recorded in up to four breeding seasons, yielding 73,456 records for evaluation. 48.9 % of records were from flying birds, the remaining records were from perched individuals. 59.7 % of the recorded flight heights were below 200 m above ground level (AGL), below the height that the rotors of the taller wind turbines currently being built. The average flight height varied between individual territory holding birds (188 - 288 m AGL), as did the median height (145 - 271 m AGL). Lesser Spotted Eagles frequently search for their prey on the ground while flying below 200 m AGL, and their field of vision when hunting is downwards and not forwards. As a result they are in danger of colliding with wind turbines, especially close to breeding sites. Lesser Spotted Eagles sometimes flew up to 1,600 m AGL (ascending at 2.1-2.4 m/sec), and flight heights of above 1000 m occurred in every month. Considering the rarity of breeding Lesser Spotted Eagles in Germany, collisions with aircraft seem rather improbable. Nonetheless, one of the five eagles in the study was killed in this way.

Bernd Meyburg is Chair of the World Working Group on Birds of Prey (WWGBP) and head of the BirdLife Germany (NABU) Federal Working Group on Bird of Prey Protection. He has satellite-tracked some 16 raptor species in Europe, Africa and Arabia since 1992.



POSTER

The influence of migration distance and duration of the breeding season on variance among individuals in the annual migratory schedule**C.M. Meier^{1*}, R. Aymi², H. Karaardic³, P. Zehindjiev⁴ & F. Liechti¹**¹ Department of Bird Migration, Swiss Ornithological Institute, Sempach, Switzerland² Catalan institute of Ornithology, Barcelona, Spain³ Department of Biology, Akdeniz University, Antalya, Turkey⁴ Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria

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The migratory journey is an undertaking with many unknowns, such as unpredictable climatic and environmental conditions en route. Actually, the longer the journey the more conditions are to overcome. These uncertainties may prevent migrants from adopting a fixed migratory schedule and consequently individuals could respond with a variety of strategies (eg. weak individuals may depart earlier, strong individuals may fly faster). Thus, we could expect large variance in departure time among individuals of long-distance migrant populations.

However, many birds arrive surprisingly on schedule at the breeding site each year, probably to fully exploit the short breeding season. Actually, populations with a short breeding season should arrive more synchronized compared to populations with a long breeding season.

On the other side, populations with a long breeding season might show more flexibility in timing reproduction but also experience more uncertainty in initiation breeding at the competitively best time. These populations should thus maximize time at the breeding site while showing increased variance in arrival and departure time at this site.

Different populations of the same migratory species thus offer the ideal setting to verify these hypotheses. Therefore, we investigated the annual migratory schedule of 155 alpine swift (*Apus melba*) individuals from four European populations along a latitudinal gradient, monitored over three years (2013-2016).

Preliminary results confirmed our hypotheses. Specifically, individuals of northern populations have a short attendance at the breeding site and duration of migration showed the highest variance during the annual cycle while individuals of southern populations showed variance in attendance time at the breeding site.



The largest source of variance in all populations was the individually different departure time. Based on these results we will discuss how the flexibility of migratory schedule potentially has consequences for local population dynamics.

Christoph Meier is a researcher at the Swiss Ornithological Institute (Sempach). He is interested in the feedback of individual behaviour on large patterns at population scale, eg. annual migration and dispersal. Currently, he is involved in researches concerning geolocators to investigate the annual variation in migratory schedules.

POSTER

Multi-colony non-breeding distributions and resource use of a generalist seabird

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Research on bird movements and resource use is often restricted to the breeding season when individuals are constrained to specific breeding areas. However, different stages of the annual cycle are often inextricably linked, with events occurring during the non-breeding season continuing to influence individuals and populations during subsequent stages. To improve our understanding of a species' biology and to manage populations of conservation concern it is therefore important to move beyond single season research. We investigated the non-breeding season of a widespread, generalist coastal seabird, the Herring Gull *Larus argentatus*, which has declined across the UK in recent decades. Using GPS tracking data we compared the non-breeding distribution and resource use of herring gulls from five colonies across south-west Scotland and Northern England. These colonies showed spatial variation in non-breeding distributions and resource use, with individuals preferentially using different habitats within each region. In addition, potentially due to intra-specific competition, individual variation in resource use occurred with larger individuals more frequently visiting intertidal habitats; and smaller individuals more frequently visiting grassland habitats. These results highlight that different resources may be more important for different populations of a species, as well as individuals, which has implications when considering the conservation and management of species.

Nina O'Hanlon is a seabird ecologist with an interest in all aspects of conservation and ornithology. She recently completed her PhD which focused on the spatial, behavioural and foraging ecology of Herring Gulls and is now looking at the effect of plastic on seabirds at the University of Highlands and Islands.



POSTER

Tracking Bewick's Swans in relation to wind farms: the importance of cumulative impact assessment**Eileen C. Rees, Larry R. Griffin & Baz Hughes**

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Serial wind farm development along migration routes is an important consideration in determining potential cumulative effects on avian populations. Tracking swan and goose migration therefore has been undertaken by WWT to inform the UK Government's Strategic Environmental Assessment (SEA) programme for offshore wind farm development, with tracks for the NW European Bewick's Swan *Cygnus columbianus* population being of particular interest because this population is in rapid decline.

Twenty-two swans were fitted with solar-powered UHF-GSM-GPS data loggers, programmed to provide GPS fixes at hourly (sometimes 30 min) intervals, transmitted remotely via the GSM phone network every 4 h. One logger fitted in winter 2013/14 and all 14 in 2014/15 were fully functional. Shapefiles were obtained for areas with proposed and operational offshore wind farm sites in the North Sea; maps of terrestrial turbines were obtained or digitised using Google/BING imagery for countries in the wintering range (UK, Netherlands, Germany) or with important staging areas (Denmark, Latvia, Estonia). Swan tracks (up to March 2016), wind farm locations and weather data from meteorological stations close to the swans' tracks were incorporated into a GIS for analysis.

A total of 45 offshore wind farm footprints (including 11 operational sites) were crossed by the swans, of which 33 (63%) were in German waters, 12 (23%) Dutch, 4 (8%) British and 2 (4%) Belgian, with particularly frequent movement across the East Anglia ONE footprint (83% of tracks and all tagged swans crossed the site in 2014–2016). Moreover, 15 swans with detailed (at least hourly) location data encountered 322 onshore wind turbines, mainly in Denmark (138; 43%), Germany (113; 35%) and The Netherlands (63; 20%), but also in the UK, Latvia and Estonia. The study illustrates the importance of considering both offshore and onshore wind farms in cumulative impact assessments. International communication and sound data on wind farm development in range states is crucial if SEAs are to determine cumulative effects more precisely.

Eileen Rees is Research Fellow at the Wildfowl & Wetlands Trust. She has studied migratory waterbirds (particularly swans and geese) for over 30 years, focussing on factors affecting their trends in numbers, distribution and phenology.



POSTER

Individual, social and habitat factors influencing multiple behavioural stages of dispersal –implications for conservation**Hugo Robles^{1,*}, Zeno Porro² & Carlos Ciudad²**¹ EVECO, Department of Biology, University of Antwerp, Groenenborgerlaan 171, BE-2020, Antwerp, Belgium² ECOGESFOR, Technical University of Madrid, Ciudad Universitaria s/n, E-28040, Madrid, Spain

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Dispersal has been traditionally oversimplified as a multi-stage (emigration/departure, transfer/exploration, immigration/settlement) process, but the identification of the multiple behavioural stages of dispersal is often arbitrary due to the limited information available during exploration and settlement stages. Using Behavioural Change Point Analysis to increase objectivity in the identification of dispersal stages, we found that dispersal can be seen as a number of consecutive “exploration waves” where a first exploratory phase is followed by temporal settlements and/or a number of secondary explorations. Radio-tracked middle spotted woodpeckers reduced search rates (meters/day, SR) and areas (SA), and increased thoroughness of search (SA/MCP), when moving on areas with high proportions of breeding habitat (old oak forest) at any dispersal stage. Moreover, high amounts of breeding habitat surrounding the natal patches were negatively correlated with SR and SA during primary explorations, which brings further support for the hypothesis that habitat loss/fragmentation may promote dispersal as a behavioural mechanism to escape adverse conditions. Further support from this hypothesis comes from the fact that juvenile dispersers increased SR and SA, and reduced thoroughness, when crossing areas covered by high proportions of low-quality structures (pine plantations, open areas) during explorations. After controlling for habitat structure, the number of neighbours surrounding the natal territory, but not the number of siblings, reduced SR and increased thoroughness, which may suggest that intra-specific competition (but not kin competition) may constrain movements in the critical early-postfledging period. Finally, we did not find evidence of an effect of individual attributes (sex, body size) on movements at the study scale. To conclude, our results indicate that dispersal is mainly driven by human-induced habitat loss-fragmentation as well as by changes in the matrix. Conservation actions aimed to reduce habitat fragmentation and to improve matrix quality may increase connectivity and reduce the risk of moving through unsuitable environments.

Hugo Robles is an ecologist with a strong focus on the link between behavioural ecology and conservation biology. Among other research themes, he is particularly interested in understanding how current human-induced environmental changes (habitat loss/fragmentation, urbanization, climate change) influences avian behaviour and its consequences on population dynamics.



POSTER

Post-fledging movement and use of anthropogenic food sources in a partial migratory population of White Storks**Kate Rogerson^{1*}, Phil Atkinson³, Inês Catry², Jenny Gill¹ & Aldina Franco¹**¹ University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ² CEABN/InBio- Rede de Investigação em Biodiversidade e Biologia Evolutiva, Instituto Superior de Agronomia, Universidade de Lisboa, 1349 - 017 Lisboa, Portugal³ British Trust of Ornithology, The Nunnery, Thetford, IP24 2PU

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During c.20th, White Stork *Ciconia ciconia* populations declined across Europe but increased from 1980. In South Iberia, the population increase has been linked to increased food availability; invasive crayfish in rice fields and organic material from landfill sites. These year-round food resources may have facilitated the Portuguese population to become partially migratory, with over half of the breeding population remaining in Portugal last winter. The effect of anthropogenic food sources on post-fledging movement is unknown. This study is taking advantage of high temporal and spatial resolution data collected from 40 juvenile white storks tracked with GPS/GSM transmitters in the 2016 breeding season.

The movement of fledglings, while they are still using the nest, is influenced by the distance between the nest and landfill sites. During this period, juveniles from nests far from landfill sites fly significantly less per day, spend a greater time on the nest and less time on landfill sites than those that are from nests located close to landfill sites. However once birds leave the nest and before crossing the strait of Gibraltar, distance between natal nest and landfill sites does not influence the time spent on landfill, distance moved per day or distance displaced per day. Although movement parameters of fledglings are influenced by the proportion of time the birds spend on landfill sites. The individuals that spend less time on landfill sites move greater distances per day and displace more per day than those that spend more time on landfill. Birds that forage in natural habitats are more mobile probably due to the need to search for prey in diverse locations.

White storks are social and the juveniles from nests located close to and far from landfill sites are possibly following non-naïve individuals to foraging areas and landfill sites.

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



POSTER

Effects of peatland restoration on foraging movements of European Nightjars

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Understanding animal movements can inform us of the importance of various resources, in order to improve the management of locations important to them. For example, foraging sites may be visited repeatedly or used less-frequently but more intensely according to resource type. The increase in the use of technology to obtain high-frequency movement data from species means that movement patterns can be integrated with resource use leading to better understanding of the animal's ecology.

This study focuses on a population of an understudied species of conservation concern in the UK, the European Nightjar *Caprimulgus europaeus* on one of the few peatland sites in the country to hold a stable breeding population. Nightjars are a cryptic, ground-nesting migrant to the UK. Using the latest GPS tags we aim to understand nightjar foraging behaviour in relation to the environmental change occurring on their breeding site. Fine-scale data was used to produce biased random bridge models, to create movement based kernel estimations. These were then used to assess habitat selection, producing a dynamic view of their breeding habitat use.

Tracking will be carried out from 2015 to 2018, to deliver fine-scale data that can help us to understand where they forage, where they breed and will allow both individual and population responses to the landscape changes be observed.

Preliminary analysis of data from 15 tracked birds in 2015 and 2016 has identified key foraging locations although there is wide population variation in both home range size and resource selection. In concurrence with the literature, nightjars are seen to select drier habitats present on the peatland, and clearly identify valuable foraging resources to which they make repeat visits.

Tracking will be carried out until 2018, to explore responses to further site management through behavioural changes in their foraging movements.

Lucy Ryan is a second-year PhD student at the University of York, with a primary interest in avian ecology and habitat management. Outside of her PhD, she is a keen C-permit ringer.



POSTER

Exploration patterns and survival of juvenile Red Kites in Switzerland

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The exploration phase represents an important step in the dispersal of juvenile birds since it considerably affects settlement decisions. Investigating the drivers of exploration patterns is central to the understanding of how informed dispersal influences spatial dynamics within and between populations. In migrant birds, post-fledging exploration movements are directly followed by migration movements in autumn. Though migration and dispersal are functionally different, it remains unclear, whether movement patterns could be assigned to the different behaviours. However, to study factors affecting pre-migratory exploration patterns it is crucial to define an end point of the exploration phase, or to integrate exploration patterns to the migration period.

We recorded the movements of over 120 juvenile Red Kites *Milvus milvus* from fledging to arrival at their wintering sites by using GPS-tracking. Separation of exploration patterns from migratory movements was done by different statistical methods. After that, we investigated examples of natal factors affecting exploration patterns while controlling for sex.

Movement patterns during the exploration phase clearly differed from those during migration. Migration showed shorter stationary behaviour and more directional movements during mobile phases. Two distinct pre-migratory exploration patterns seem to emerge in our study population. We found evidence for a relationship between natal conditions during the nestling period and the type of exploration.

Our results are consistent with the idea that exploration and migration are clearly separated spatial processes. This allows distinguishing between pre-migratory spatial behaviour and migration movements, and understanding factors affecting the pre-migratory exploration phase of dispersal.

Patrick Scherler is a PhD student in Ecology at the University of Zurich and the Swiss Ornithological Institute working on the dispersal behaviour of Red Kites in Switzerland. His main focus lays on exploration strategies, carry-over effect of fledging condition on movement trajectories and first year survival rates.



POSTER

Understanding different wintering strategies of five species of waterbird through GPS telemetry

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Understanding space use by coastal species is increasingly important with the advent of renewable energy developments adding to existing pressures on coastal areas. The Severn Estuary Special Protection Area and Ramsar Site supports nationally and internationally important populations of wintering waterbirds, many of which are declining. The estuary has one of the largest tidal ranges in the world and a 22km tidal lagoon is proposed near Cardiff.

To better understand how species and individuals use the area, and to more accurately assess potential effects of the lagoon and decide how to mitigate for its impact, GPS tracking devices were attached to 121 birds of five species: Eurasian Curlew, Common Redshank, Common Shelduck, Eurasian Teal and Eurasian Wigeon, over winter 2015-16 and alongside estuary-wide waterbird surveys. Dunlin were also dye-marked to allow study of their movements.

Home ranges were largest for Redshank, then Curlew, Wigeon and Teal. Those for Redshank were around 10 times larger than previous studies suggested, but were more comparable for Teal; we found no previous figures for Curlew or Wigeon. Redshank moved further than expected in order to exploit nearby terrestrial habitats, and did so largely at night. Wigeon and Teal also exploited different areas at night; however Curlew did not. Curlew caught at two different roosts 8km apart overlapped little in range. Dunlin were regularly seen on the opposite side of the estuary, despite previous work suggesting that such movements were rare. Teal were extremely site-faithful and used very little intertidal area. Some Shelduck moved away from the study site, preventing un-biased data analyses but suggesting development may affect more individuals less strongly.

These data will validate Individual-Based Models that will be used to predict potential lagoon impacts: this work considers individuals' behaviour alongside population metrics and thus represents an improvement to Environmental Impact Assessments.

Emily Scragg works as a Research Ecologist in the Wetland and Marine team at the British Trust for Ornithology. She is interested in understanding how and why birds move, and how technology can



further our knowledge of bird movements and behaviour, particularly in relation to anthropogenic effects.

POSTER

Host-parasite interactions and population dynamics of rock ptarmigan in Iceland

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Populations of Rock Ptarmigan *Lagopus muta* in Iceland fluctuate in multiannual cycles with peak numbers c. every 10 years. We studied the ptarmigan-parasite community and how parasites relate to ptarmigan body condition and population density in NE Iceland early October, 2006-2012. From 632 collected ptarmigan, 630 (99.7%) were infected with at least one parasite species, 616 (98%) with ectoparasites, and 536 (85%) with endoparasites. We analysed indices for the combined parasite community (16 species) and known pathogenic parasites, two coccidian protozoans *Eimeria muta* and *E. rjupa*, two nematodes *Capillaria caudinflata* and *Trichostrongylus tenuis*, one chewing louse *Amyrsidea lagopi*, and one skin mite *Metamicrolichus islandicus*. Juveniles overall had more ectoparasites than adults, but endoparasite levels were similar in both groups. Ptarmigan population density was associated with endoparasites, and in particular prevalence of the coccidian parasite *E. muta*. Annual aggregation level of this eimerid fluctuated inversely with prevalence, with lows at prevalence peak and vice versa. Both prevalence and aggregation of *E. muta* tracked ptarmigan population density with a 1.5 year time lag. The time lag could be explained by the host specificity of this eimerid, host density dependent shedding of oocysts, and their persistence in the environment from one year to the next. Ptarmigan body condition was negatively associated with *E. muta* prevalence, an indication of their pathogenicity, and this eimerid was also positively associated with ptarmigan mortality and marginally inversely with fecundity. There were also significant associations between fecundity and chewing louse *A. lagopi* prevalence (negative), excess juvenile mortality and nematode *C. caudinflata* prevalence (positive), and adult mortality and skin mite *M. islandicus* prevalence (negative). Though correlational, this study provides strong evidence that *E. muta* through time-lag in prevalence with respect to host population size and by showing significant relations with host body condition, mortality, and fecundity could destabilize ptarmigan population dynamics in Iceland.



Ute Stenkewitz is a wildlife researcher and conservationist about to complete her PhD at the Icelandic Institute of Natural History and University of Iceland. Ute has been exploring how parasites relate to population dynamics of the rock ptarmigan in Iceland.

POSTER

Discovering the migration and non-breeding areas of Sand Martins *Riparia riparia* and House Martins *Delichon urbicum* breeding in the Pannonian basin (central-eastern Europe)

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The central-eastern European populations of Sand Martin *Riparia riparia* and House Martin *Delichon urbicum* have declined in the last decades. The drivers for this decline cannot be identified as long as the whereabouts of these long distance migrants remain unknown outside the breeding season. Ringing recoveries of Sand Martins from central-eastern Europe widely scattered recoveries in the Mediterranean basin and in Africa, suggesting various migration routes and a broad non-breeding range. The European populations of House Martins are assumed to be longitudinally separated across their non-breeding range and thus narrow population-specific non-breeding areas are expected. By using geolocators, we identified for the first time, the migration routes and non-breeding areas of Sand Martins (n=4) and House Martins (n=5) breeding in central-eastern Europe.

In autumn, the Carpathian Bend and northern parts of the Balkan Peninsula serve as important pre-migration areas for both species. All individuals crossed the Mediterranean Sea from Greece to Libya. Sand Martins spent the non-breeding season in northern Cameroon and the Lake Chad Basin, within less than a 700km radius, while House Martins were widely scattered in three distinct regions in central, eastern, and southern Africa. Thus, for both species, the expected strength of migratory connectivity could not be confirmed.

House Martins, but not Sand Martins, migrated about twice as fast in spring compared to autumn. The spring migration started with a net average speed of > 400 km/day for Sand Martins, and > 800 km/day for House Martins. However, both species used several stopover sites for 0.5-4 days and were stationary for nearly half of their spring migration, based on our arbitrary but objective rules used to define stationary periods. Arrival at breeding grounds was mainly related to departure from the last sub-Saharan



non-breeding site rather than distance, route, or stopovers. We assume a strong carry-over effect in spring in timing.

Tibor Szép is a biologist with main research focus on population processes of long-distance migrants and development of indirect methods for identifying wintering/migration areas. He lead long-term integrated monitoring of Sand Martins in Hungary and interested to apply new approaches for identifying factors behind the decline of long distance migrants.

POSTER

Tracking Lesser Black-backed Gulls from three colonies reveals vulnerability of breeding populations to wind farms through the year

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To minimise the impacts of climate change, a rapid expansion in renewable energy developments including wind farms is currently taking place. As a result, there is a need to understand the scale of potential impacts from such developments on biodiversity and species' populations.

Lesser Black-backed Gulls *Larus fuscus* are considered sensitive to collision risk with wind farms. Through the year, the species uses both inland and offshore habitats, with birds from the UK wintering here as well as in Iberia and North Africa. However, a year-round appraisal of the extent of their vulnerability to wind farms has not been carried out. Using high-resolution GPS telemetry, we quantified the relative potential risk and vulnerability of three protected UK breeding populations of Lesser Black-backed Gulls to collision with onshore and offshore wind farms through their annual cycle. Using General Additive Mixed Effects models (GAMMs) we produced a modelled surface of distance travelled within a bespoke collision risk window to approximate potential risk to wind farms. This surface was then combined with wind turbine density to evaluate spatio-temporal vulnerability.

Vulnerability was highest near to colonies during breeding. However, vulnerability was also high outside the breeding season, notably in northern Spain at a migration bottleneck, as well as key wintering areas in southern Spain and Portugal. This study has, for the first time, revealed the relative vulnerability of a migratory species to renewable energy developments across its annual cycle, through the year, across onshore and offshore habitats and across international boundaries. In so doing, the study highlights the



need to consider cumulative effects year-round in assessing the potential impacts of developments on protected site populations. This study provides a fuller picture of wind farm interactions, allowing better assessment of potential anthropogenic impacts on our internationally-important seabird populations.

Chris Thaxter is an ecologist with a research focus in wildlife behaviour and conservation, specialising in marine ecosystems. He is particularly interested in seabird behaviour and movement patterns in relation to anthropogenic and environmental processes, and how fine-scale species-environment interactions link to population processes, furthering conservation and management of species.

POSTER

Does site fidelity increase foraging efficiency?

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Site fidelity, the tendency to return to and reuse a particular area, is a well-known phenomenon and has been observed in many taxa. Fidelity for foraging areas might increase foraging efficiency through improved local knowledge about the quality and predictability of prey. Individuals that are site faithful might also experience less competition and aggression when they know their neighbours, leaving more time for active foraging. However, these hypotheses have barely been empirically tested. Gulls are suitable species to study consequences of site fidelity as individuals within populations show great variety in their foraging behaviour, both in the foraging areas they select as in the level of site fidelity.

Furthermore, they are big enough to carry GPS trackers that can also register behaviour at a high spatial and temporal resolution. We studied the foraging efficiency of individual Herring Gulls *Larus argentatus* with varying site fidelity breeding on the island of Texel, The Netherlands. We expected that site faithful individuals will spend more time on active foraging than on other behaviours like flying, social interactions and searching. We tracked individual gulls and logged tri-axial acceleration using GPS trackers attached to the backs of the herring gulls. Using this data and applying machine learning techniques we quantified behaviour of herring gulls with different levels of site fidelity while foraging on their primary food source, the blue mussels *Mytilus edulis* that are found on breakwaters along the coast near the breeding grounds. This method enabled us to accurately classify 95.7% of the gulls' behaviour relevant for answering this research question. We show how the time spent actively foraging is related to foraging site fidelity and present an innovative way of studying the consequences of site fidelity.



Susanne van Donk is a behavioural ecologist mainly interested in the consequences of individual differences in behaviour. She is studying whether foraging strategies in the herring gull affect fitness and energy budgets and whether individuals with variable strategies respond differently to changes in their environment.

POSTER

Crossing the North Sea: behaviour of nocturnal migrants encountering an ecological barrier

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Barriers impose important challenges to migrants, as these are often unsuitable or hostile environments to rest and refuel. Crossing barriers, therefore, is thought only to occur under favorable conditions, when the chances of success are the highest. Large water bodies can be perceived as ecological barriers to terrestrial migrants, such as nocturnal migrating birds. These are often small passerines that cannot land and rest on water. This study focused on the behaviour of nocturnal migrants from northwestern Europe during autumn when encountering an important barrier: the North Sea. The aim of this study was to assess under which conditions the birds cross the North Sea. We assumed that when conditions are favorable, being tail winds, birds do cross the North Sea from Norway and Denmark to The Netherlands and the UK, and from The Netherlands to the UK. To test this hypothesis, we extracted information on bird migration from 15 weather radars in the OPERA network. Countries included were United Kingdom, Belgium, The Netherlands, Germany, Denmark and Norway. Data was gathered for the months September and October 2016. North Sea crossings were identified based on flight directions and densities along opposite coastlines, while local weather conditions at departure were analyzed. With this study we present a first European multi-radar analysis of broad scale behaviour of nocturnal migrating birds encountering an ecological barrier.

Liesbeth Verlinden is a biologist with an additional MSc in Applied Statistics and Datamining. Her main research interest is bird migration. She is currently involved in a project that uses the European weather radar network to investigate broad scale behaviour of nocturnal migrating birds encountering different environmental conditions.



POSTER

Impact of Urbanization on Common Birds of Himalayas**Virat Jolli**¹ Biodiversity and Environmental Sustainability, 1st Floor, 143, F-17, Sector-8, Rohini, New Delhi-110085, India.² Department of Environmental Studies, Shivaji College (University of Delhi), Raja Garden, New Delhi-110027, India.

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Rapid urbanization in Himalayas is a potential threat for the Himalayan Wildlife. The wilderness of Himalayas is under threat due to expansion of highways, increase in tourism industry, and development of hydroelectric projects. Government of India's development initiatives in the mountains though has improved the standard of living of people however it has caused migration of youth from rural areas to towns and cities for better education, employment and business. All these factors have resulted in expansion of towns and cities in Himalayas. In near future many new towns and cities will emerge in the Himalayas which will change its landscape. Himalayas is known for its rich diversity of flora and fauna. They are unique and sensitive to habitat modifications therefore urbanization will likely to affect their population, diversity, and community composition. In the current study, in order to understand the response of birds to urbanization, five most abundant bird species (Jungle Crow *Corvus macrorhynchos*, Rock Pigeon *Columba livia*, Common Myna *Acridotheres tristis*, Himalayan Bulbul *Pycnonotus leucogenys*, and House Sparrow *Passer domesticus*) across all sites were selected and correlation analysis were made between average abundance of individual bird species with respect to percentage of predominant land use type in study area. Line transect method was used to estimate bird abundances in Mandi, Dharamshala, Palampur and Kangra Towns. Land use of each transect (1 × 0.1) Km was estimated using Google Earth satellite images and land features were identified and processed using ArcGIS 9.3 ver. The results suggested, the total area under builtcover was highest in Mandi followed by Kangra and Dharamshala. Palampur had lowest area under builtcover among all studied towns. Area under treecover was highest in Palampur followed by Dharamshala while Kangra and Mandi had low treecover. Area under Parkland/Agricultural land is highest in Kangra followed by Palampur and Dharamshala while lowest in Mandi. Correlation analysis of five bird species with percentage of area under builtcover, treecover and parkland/agricultural were made. Himalayan Bulbul, Jungle Crow showed very strong significant positive correlation ($r = 0.92$) with percentage of builtcover whereas Common Myna abundance increase moderately. Jungle Crow, Common Myna and Himalayan Bulbul showed significant negative correlation with percentage of treecover. Rock Pigeon responded positively to parkland/agriculture land whereas House sparrow, Jungle Crow and Himalayan Bulbul responded negatively. The study revealed that in near future with increase in urbanization bird species like Jungle Crow, Himalayan Bulbul and Common Myna population likely to increase in towns of Western Himalayas.

Virat Jolli is an environmental biologist with research interest in ecology and conservation of Himalayan birds. He is currently the President of Biodiversity and Environmental Sustainability and conduct



programs on environmental awareness in parts of Himalayas. He is also engaged in teaching Environmental Science to undergraduate courses in University of Delhi, India.

POSTER

Predicting the impacts of spatial change on seabirds: an Individual Based Model

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Individual Based Models (IBMs) provide a robust approach to predict the colony-specific impact of spatial change on animal populations and support evidence-based decision making for conservation planning. There are increasing proposals for windfarm developments in UK waters, and seabirds are a vulnerable group which may be at risk from these developments. We developed an IBM to investigate the potential impacts of the installation of windfarms in the English Channel and North Sea on body mass, productivity and mortality of a breeding population of Northern gannets for which we have tracking data. Our model is spatially-explicit, and incorporates direct and indirect interactions between birds and their environment which previous models have not included. A baseline model with no windfarms accurately represented the status of a sample of tracked gannets at the end of the 90 day chick-rearing period, and the behaviour-time budget was similar to that of tracked gannets. Model simulations in the presence of windfarms indicated that installations should have little impact on the gannet population when either avoidance behaviour or collision risk scenarios were simulated. Our model can be adapted for other seabird populations or to predict the impacts from other types of spatial change in the marine environment.

Victoria Warwick-Evans is a marine biologist with a main research focus on the spatial distribution of seabirds. She is particularly interested in modelling seabird foraging behaviour, and investigating the potential impacts of anthropogenic disturbance on seabirds.



POSTER

The link between migratory decisions and juvenile survival in White Storks

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In the last few decades, changes in the migration behaviour of many bird species have become apparent (e.g. a shift in timing or a shortening of routes). Such changes may be linked to changes in the global climate, an increase in human activities or habitat degradation. The White Stork *Ciconia ciconia*, a well-studied long-distance migrant, is known to mainly breed in Europe and overwinter in Africa, but recently the wintering populations in the South of Europe such as France and on the Iberian peninsula are growing rapidly. It is so far unclear which environmental and/or social factors contribute to the decisions of immature individuals to choose a wintering quarter (e.g. Europe or Africa) and what effect this decision has on population dynamics. Here, we estimate the survival probability of GPS tagged stork fledglings to test whether individual properties such as hatching order, different movement parameters, or energy expenditure affect survival. Further we estimate the long-term implications of the differing mortality hazards on the population. Preliminary results show that chicks that hatch later are more likely to stay in Europe for the first winter and have a higher survival chance. Our study will contribute to a better understanding of the relationships between individual behaviour, population responses and the adaptations of migrants in a changing world.

Yachang Cheng is a PhD student with a main research interest in avian migration and bio-logging. She is especially fascinated by when, where, how and why animals die, including the consequences related to conservation aspects. She is also interested in migration strategies and flight behaviour.



POSTER

High mobility of Red-throated Divers *Gavia stellata* revealed by satellite telemetry**Ramūnas Žydelis^{1*}, Monika Dorsch², Stefan Heinänen¹, Birgit Kleinschmidt^{2,3}, Julius Morkūnas⁴, Petra Quillfeldt³ & Georg Nehls²**¹ DHI, Agern Allé 5, Hørsholm 2970, Denmark² BioConsult SH, Schobüller Str. 36, Husum 25813, Germany³ Justus Liebig University Gießen, Gießen 35392, Germany⁴ Klaipėda University, H. Manto g. 84, Klaipėda, Lithuania

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Red-throated Divers *Gavia stellata* occur in temperate coastal areas of the Northern Hemisphere during the non-breeding period. Knowledge about this species, however, remains fragmented. Especially the origin of locally observed birds and movement ecology of this sensitive species is usually unknown, which hinders conservation and management decisions related to human developments in marine environment.

We equipped Red-throated Divers with implantable Argos satellite transmitters in the German North Sea and successfully tracked 27 individuals during varying periods in 2015-2016. The birds were caught during the wintering period between February and April when their abundance peaks in the eastern North Sea. The aim of this presentation is to characterize the mobility and space utilisation of divers during the annual cycle by analysing bird occurrence in jurisdiction zones of different countries. We applied generalised additive mixed models to predict probabilities of diver occurrence in waters of separate countries during each day of the year.

Red-throated Divers captured within a small offshore area dispersed widely during the rest of the year. During the breeding season birds dispersed from Taimyr Peninsula, Russia, to western Greenland. Many individuals showed high mobility during the entire non-breeding period alternating between separate staging, moulting and wintering grounds. Assessment of the area use by jurisdiction zones revealed that tracked divers cumulatively visited all countries surrounding the Baltic Sea and the North Sea. The wintering ground with highest probability of use was German and Danish waters, close to where the birds were caught. During spring migration Latvian EEZ was particularly important. Russia had the highest probability of diver occurrence in summer, and Latvian and Estonian EEZs in autumn. Our results show that Red-throated Divers are particularly mobile birds using multiple areas in the course of the year and each individual spends significant time in jurisdiction areas of several countries.

Ramūnas Žydelis is a marine ornithologist with research focus on bird habitat utilization, movements and foraging ecology.