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OFFERED ORAL PRESENTATION

Foraging for a foothold in a novel environment: diet specialisation influences reintroduction success

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In many bird reintroduction programmes, there are dual objectives of successfully re-establishing a missing species and restoring their ecological role, for example as pollinators or seed dispersers. While there are challenges in achieving both of these objectives, much more attention is paid to species recovery with the assumption that ecosystem recovery will naturally follow. Ensuring both goals are met may be enhanced by recognising that individuals within species behave differently even when faced with similar environmental challenges. If this variation has consequences for individual survival and pollination or dispersal efficiency, then managers could manipulate their reintroductions to best achieve species- and ecosystem-level objectives.

We tested these ideas in the Hihi (*Notiomystis cincta*), a threatened New Zealand passerine and important pollinator of several native plants. As a species, Hihi have a broad diet, but we found that individual diets vary widely, with generalists surviving significantly better than specialists. By tracking dietary changes during a reintroduction, we found that individuals shift toward a more generalist diet in the early stages of establishment, likely due to competitive release. However, as the population grows, individuals may seek refuge from competition through niche partitioning, highlighting a long-term need for diverse food sources at the release site.

Finally, we conducted a multi-site study comparing pollination outcomes across sites with and without Hihi. Our results suggest that, in degraded habitats, non-native pollinators may compensate for (and even exceed) the services provided by native pollinators. This information could be used by conservation managers to select release sites where Hihi could have the greatest restorative effect. Within a Hihi site, pollination outcomes also varied across Hihi territories, suggesting that behavioural trait variation could be used to identify superior pollinators. Combined, these results suggest a path forward for ecosystem restoration that uses behavioural and environmental variation to improve reintroduction success.

All presentations in alphabetical order by presenting author

Caitlin Andrews is fascinated by how behavioural variation at the individual level can be used to improve conservation efforts at multiple levels of the ecosystem. She enjoys working with a range of species and, before embarking on a PhD with Hihi, spent time studying primates, grey parrots, and domestic dogs.

KEYNOTE

Managed wetland restoration and bird populations

Malcolm Ausden
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Pressures on wildlife are expected to increase, mainly because of climate change and further agricultural intensification in response to increasing global food demand. Against this backdrop, I will argue that, in the cultural landscapes of most of lowland Europe, the best approach to restoring wetland bird populations is to: 1) Manage wetlands that have already been heavily modified by people in ways that maximise their value for birds and other wildlife, and also enable people to connect with nature; 2) Design new wetlands to provide valuable habitat for birds and other wildlife and also deliver other public benefits.

I present examples of wetland management techniques that have benefitted birds of high conservation concern. I describe wetlands where the design, as well as providing valuable wildlife habitat, reduces flood risk. I also consider the effects of different wetland habitats on climate regulation, and the trade-offs between maximising benefits for wetland birds, and maximising other ecosystem service benefits. Further examples show wetlands which have been designed to take into account expected changes in water availability and sea levels, and which have been designed so they can be managed to provide a continuity of early successional wetland habitat.

I conclude by highlighting future challenges and opportunities for wetland restoration.

Malcolm Ausden is Principal Ecologist at the RSPB. His main role involves advising on habitat management and habitat creation on the RSPB's network of UK nature reserves. This has included leading on the ecological design of Wallasea Island Wild Coast, the largest coastal wetland creation project in the UK. He has published about 40 papers, articles and book chapters, mostly about habitat management, and mainly aimed at conservation practitioners. He is also a keen artist.

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OFFERED ORAL PRESENTATION

Choosing an unsuitable site for reintroduction: the case of Madagascar Pochard

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Standard rules for species translocation dictate that species' needs are understood, that the release site is in appropriate condition, and that the threats which caused the species' decline are understood and have been minimised. None of these requirements could be honestly addressed for the Madagascar Pochard, a diving duck that suffered large declines in the early 20th century and was believed extinct until a remnant population was discovered in 2006.

Trying to save a species limited to fewer than 30 individuals at just one site, we were faced with a remnant population surviving at a site that is atypical for the species. An absence of historical ecological studies meant a very incomplete understanding of how the pochards would be impacted by the large range of threats found in wetlands across the country. National surveys revealed no potential release sites capable of supporting the pochard. In fact, the picture was of widespread wetland degradation, which also meant an absence of good condition reference sites to guide research and ecosystem restoration efforts.

Lake Sofia, although degraded, was chosen as a reintroduction site. Here we present the rationale developed to reintroduce pochards to a potentially unsuitable new site in the absence of required data, using an adaptive programme of research alongside conservation actions and trial releases, to ensure that the approach remained on the right side of agreed reintroduction requirements and methods.

Andy Bamford is an ecologist with broad interests in animal behaviour and conservation. He has spent most of his working life researching mammals and birds in various parts of Africa, and has been working on the Madagascar pochard and Malagasy wetlands since 2011.

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POSTER

Is bird diversity the best measure of habitat importance? A New Forest Perspective.

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Biodiversity is declining on a global scale despite efforts to the contrary. Many UK birds have declined since the 1960s, and are now classified as endangered or rare. Birds are effective indicators of ecosystem health, occurring in almost every habitat on Earth. Therefore, habitat diversity affects avian diversity attesting that birds are a vital resource to conservationists. Not only are the birds influenced directly by their immediate habitat, they are also indirectly affected by the surrounding landscape, indicating the need for local and landscape-level studies and management.

This study takes a multi-scale approach to examine bird-habitat relationships in the New Forest National Park in southern England. The New Forest landscape is predominantly broadleaved woodland, interspersed with conifer plantations and lowland heath. Recently acquired, high resolution airborne remote sensing datasets (LiDAR) were used to develop metrics that quantify structure. In addition, ground surveys were used to quantify vegetation composition and overall condition of habitats in the study landscape. Measures of bird density, species richness and diversity, and also the number of declining bird species, conservation priority and rarity were calculated from plot based breeding bird surveys and related to vegetation structural metrics and vegetation composition to determine the effects of landscape characteristics.

The study showed that bird-habitat relationships differ depending on the measure of birds: bird diversity was highest in successional scrubland, whilst the highest number of bird species with declining populations were in beech woodlands, and the rarest bird species were in the heathland and the non-pine conifer plots. This demonstrates that habitats which increase bird diversity may not be suitable for rare or declining species. This also indicates that management strategies should incorporate multiple measures of bird-habitat relationships and that increasing habitat heterogeneity at the landscape scale is required in order to conserve overall landscape bird diversity.

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Ailidh Barnes is nearing the end of her PhD in "Modelling mitigation of bird population declines in the UK through landscape-scale environmental management" at Bournemouth University. She is a keen birder having her C ringing permit and also experience organising and carrying out breeding bird surveys, specialising in avian ecology.

POSTER

Resilience to breeding population declines: evidence for the buffer effect in the Common Guillemot

Sophie Bennett[1,2*], Sarah Wanless[1], Mike Harris[1], Mark Newell[1], Kate Searle[1], Jon Green[2] & Francis Daunt[1]

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As more bird populations decline and face multiple anthropogenic threats, understanding the parameters that govern key demographic rates such as productivity becomes increasingly vital for effective population restoration. When populations experience declines in size, individuals are predicted to preferentially occupy the highest quality sites. Additionally, fewer new sites, which are of lower quality, are expected to be established. As the population increases, higher quality sites become limiting, forcing pairs to occupy those of lower quality, which are often peripheral to the colony– a process known as the 'buffer effect'.

However, few studies have tested whether this regulatory process operates in populations experiencing variation in population trends. Here we use time series data from a population of Common Guillemots *Uria aalge* on the Isle of May, south-east Scotland, which has shown sustained periods of population increase, decrease and stability over the last 40 years, to investigate the effect of changes in population status on breeding site occupancy and quality.

We found that higher quality sites were preferentially occupied when the population size was low, hence average breeding site quality was higher. However, contrary to the predictions of the buffer effect, new sites were established when the population was declining or stable. These results suggest that the buffer effect may enable populations to recover from periods of decline.

Sophie Bennett is a PhD student researching the year-round population ecology and behaviour of seabirds. Her work focuses on understanding the drivers of individual variation in behaviour and how this scales up to population-level change through investigating breeding performance, winter colony attendance and the spatial movements of Common Guillemots.

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OFFERED ORAL PRESENTATION

Can trait-based bird assemblages predict species-level responses to landscape structure? Informing conservation interventions in Neotropical human-modified landscapes

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Sustaining bird populations in human-modified tropical landscapes is essential for biodiversity conservation and the maintenance of ecosystem services. Designing effective conservation actions to support bird populations necessitates detailed knowledge of how species and communities will respond to further disturbance and habitat change. However, tropical bird communities often contain a large proportion of rare species; with few detections it can be difficult to ascertain how an individual species might respond to disturbance in structurally complex landscapes. One potential means of over-coming this difficulty involves grouping species according to their functional traits and habitat preferences, and examining group-level responses to landscape structure.

We investigated this approach using over 36,000 bird detections collected during 1520 point counts, located across a human-modified landscape in the Republic of Panama. We divided species into eight groups according to dietary traits and habitat preferences. Using a Poisson-Binomial mixture model, we examined avian responses to proportion of forest cover and extent of fragmentation at three scales: 10ha, 50ha and 500ha. Within-group responses to landscape features varied among spatial scales. Species responded consistently within groups to local scale features (i.e. in the surrounding 10ha). However, at the landscape scale (i.e. the surrounding 500ha), species' responses varied within group, suggesting that trait-based groupings may be less suitable for predicting species' responses to wider-scale landscape change. To demonstrate how this approach could be applied in conservation planning, we selected five example species with contrasting responses to landscape features. We predicted abundance for these example species across the landscape, identifying range edges and areas that may be acting as bottlenecks, pinpointing where interventions might have the greatest effect. Highlighting key areas that restrict avian distributions in this way may facilitate more effective conservation interventions.

All presentations in alphabetical order by presenting author

Tom Bradfer-Lawrence is currently finishing a PhD on the bird assemblages of a human-modified landscape in Panama. He is interested in finding ways to maximise the biodiversity potential of such landscapes, and integrating new research methods in wildlife monitoring, particularly ecoacoustics.

POSTER

Avian control of herbivorous insects: is it negatively or positively impacted by anthropogenic habitat degradation?

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Ecosystem functions such as the control of herbivorous pests are performed by birds and other animals. Despite this, we do not yet know what the specific contribution of birds is in maintaining these functions, or how habitat quality in turn affects the bird communities that perform these functions. Here, we investigate how the predation of herbivorous insects is influenced by habitat degradation, focusing on a tropical montane forest system, the Taita Hills, SE Kenya, a highly fragmented landscape where remnant endemic forests show high variation in quality as a result of human disturbance.

We conducted a series of sentinel prey experiments (using model "caterpillars") in six forest fragments (incorporating varying degrees of habitat degradation) to quantify the direct predatory effects of insectivorous birds. Plasticine "caterpillars" were placed on understorey vegetation in designated plots and were inspected for signs of attack after 24, 48 and 96 hours, with attacks categorised to a broad taxonomic level. Point counts of bird species in all of the habitat types were also carried out to determine species presence/absence and abundance. Preliminary data indicated that bird predation equated to >75% of all attacks and that the overall ratio of these attacks were higher in more disturbed habitats than more 'pristine' indigenous forest interiors.

We conclude that predation by insectivorous birds is positively correlated with more fragmented and degraded montane forests surrounded by an agricultural matrix. This result is supported by our survey data, showing greater overall bird species diversity and abundance in forest edges and more degraded forests. These results also indicate that insectivorous forest-specialists tend not to be found in the more disturbed habitats. This highlights the difficulties of conserving forest-

specialists and ensuring the continued maintenance of the ecosystem functions they perform in habitats which continue to be degraded due to human activities.

Gino Brignoli is a first-year PhD student with research interests in functional ecology and species interactions. He is particularly interested in developing models that incorporate anthropogenic effects that can be used to influence applied conservation actions and inform policy decision-making.

POSTER

Carryover effects of trans-Saharan migration are less important than breeding site for condition, phenology and reproductive success

Claire Buchan[1]*, James Gilroy[1], Inês Catry[2], Javier Bustamante[3], Alina Marca[1], Philip Atkinson[4] & Aldina Franco[1]

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Conditions experienced by an individual during one season can have consequences for fitness in subsequent seasons; different migratory experiences can therefore result in fitness differences in the following breeding season. The greater the difference in migratory conditions experienced, the more pronounced we might expect the variation in fitness to be. Partial migration – where migratory and non-migratory individuals exist within the same population – represents a powerful natural opportunity to explore these potential carry-over effects of migration on fitness.

We present results of an analysis on a unique example of partial migration, in which migrants undertake long-distance trans-Saharan migration, while residents remain year-round on the breeding grounds. Using a combination of geolocator data, stable isotope analysis and resighting data, we examine the impacts of this stark difference in migratory strategy on body condition, breeding phenology, breeding success, and trophic level.

We monitored four colonies of lesser kestrel (*Falco naumanni*) in two regions of southern Spain across four years, resulting in 1954 individual captures, from which we determined migratory strategy for 141 adult bird-years. Despite an approximately 3000-kilometre difference in distance travelled between migrants and residents, we find no effect of migratory strategy on any

breeding parameters. We find evidence for a short-term carryover effect on body condition: at the start of the breeding season, migrants were in worse condition than residents in a region with poor primary productivity, while migrants and residents were in equal condition in a region with relatively higher primary productivity. This effect does not, however, persist throughout the breeding season. Our results indicate that effects of migratory strategy are idiosyncratic, and interact with effects of conditions experienced on breeding grounds. Furthermore, we find that, regardless of breeding region, residents feed at higher trophic levels than migrants, suggesting a link between migratory strategy and dietary specialism in this species.

Claire Buchan is a PhD student at the University of East Anglia studying changes in migratory behaviour and fitness consequences of different migratory strategies.

OFFERED ORAL PRESENTATION

A three-pronged approach to recovering the critically endangered Plains-wanderer – the world's most evolutionary distinct endangered bird

Matt Cameron* & David Parker
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The Plains-wanderer *(Pedionomus torquatus)* is a grassland bird endemic to eastern Australia. The species is the sole representative of its family and is considered one of the most evolutionary distinct birds in the world. Recently, the Plains-wanderer has declined dramatically in its strongholds and is now critically endangered. In 2015, a conservation project aimed at securing the bird's future in its primary stronghold, the Riverina region of southern New South wales, was developed and is being implemented. It has three critical actions: implement a landholder stewardship program, undertake landscape-scale predator control, and establish a captive insurance population.

Most Plains-wanderer habitat occurs on private land, and recovery is dependent on landholder co-operation. Past efforts at getting landholders to adopt Plains-wanderer friendly grazing practices failed, so we pioneered a new approach were landholders decide what assistance they need to deliver conservation outcomes and are trusted to deliver these without recourse to complex management agreements or legal instruments. We are creating landscape-scale baiting projects to mitigate the threat posed by the European Red Fox *(Vulpes vulpes)* and are working toward the construction of a predator-proof fence around a large area of habitat on public land. We are establishing a captive insurance population to buy us time to get effective habitat management and predator control in place, and to produce birds to bolster wild populations.

We will describe the approach used to gain landholder participation, and how this translates into a robust long-term shift in grazing practices that benefit Plains-wanderers and grassland ecosystems. We will report on progress toward achieving the goals established for each of the three critical recovery actions, including barriers to implementation, problem solving, and future challenges. We will provide an update on the status of the species and give prognoses for the future under different management scenarios.

Matt Cameron is a conservation biologist working on the recovery of plants and animals in southern Australia. He has worked in the field of natural resource management for more than 20 years, specialising on grassland and woodland ecosystems. He is the author of *Cockatoos* and *Parrots: The Animal Answer Guide*.

KEYNOTE

Cultural and social values in restoring bird populations – why this matters

Mary Colwell
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Restoring a vibrant natural world certainly requires science to guide us to the right actions, but without garnering the citizens of the world it will struggle to find momentum. How do the facts of science translate into meaningful action across every level of society? This can only be done by using the right language, telling meaningful stories and touching people's hearts. We need to find enchantment in nature through language, story and soul. David Attenborough put it another way, he urged people to fall in love again with the earth.

Out of all the groups, birds have the easiest job. They look and sound beautiful and many species live alongside us. Bird soul-stories have been around for as long as there have been people on earth. Meaningful tales have been handed down through the generations and we should rediscover them.

Stories are powerful motivators, as Richard Thaler in his ground-breaking book on 'nudge theory' explores. People are calm and rational for sure, but we are also emotional beings and prone to all kinds of less-than-rational behaviours. None of us operates on the pure logic of Dr Spock. By engaging with this, rather than fighting it, effective solutions are more likely to be found. We can

be 'nudged' to do the right thing by igniting our hopes, our loyalties, affiliations, cultural pride and love of traditions. The birds of the world deserve us to explore all avenues to help them.

Mary Colwell is a producer and writer interested in all aspects of the natural world. She is particularly drawn to the complex and shifting interface between wildlife and society, where the most inspiring and difficult issues lie. She is a trustee of New Networks for Nature, a yearly conference that brings together scientists, conservationists, artists, writers and musicians to celebrate nature through different lenses.

POSTER

Re-introduction of Red-billed Chough in Jersey, Channel Islands

Elizabeth Corry
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Red-billed Choughs *Pyrrhocorax pyrrhocorax* (hereafter: choughs) are specialist invertebrate feeders found in mountain or coastal regions of Europe, North Africa, and Asia. Choughs are listed as Least Concern by IUCN. However, in the British Isles, the population has become fragmented with less than 500 breeding pairs.

Choughs became locally extinct on Jersey, and the other British Channel Islands, at the turn of the 20th century. Changes in agricultural practices and, to a lesser extent, human persecution (including egg collecting) led to their demise. Many of Jersey's coastal farmland bird species have or are facing a similar threat.

Birds On The Edge, a multi-partner project, was established in 2010 to restore Jersey's depleted bird populations through management of coastal farmland, and to reintroduce the chough, which will help drive habitat restoration. Durrell Wildlife Conservation Trust manages the re-introduction with a captive breeding programme at Jersey Zoo.

Soft-releases of 43 captive-bred birds were conducted between 2013 and 2018. Birds were released in small cohorts, replicating normal family group size, and provided with supplemental feed post-release. All birds were fitted with leg rings and VHF-transmitters to determine survival, dispersal, and foraging habits. Annual survival was high (93.7%) once the birds reached their first year at liberty. Successful breeding in the wild started in 2015 further supporting population growth.

Future efforts will focus on understanding feeding ecology, so supplemental feeding can be minimized, and estimating the carrying capacity for Jersey. Further release of unrelated birds may be attempted (in future?) to increase genetic diversity.

Elizabeth Corry manages the chough reintroduction project for Durrell Wildlife Conservation Trust in Jersey. She has worked on several of Durrell's *in situ* conservation projects over the past 16 years including St. Lucian Iguana, Galápagos Finches and Montserrat Galliwasp.

KEYNOTE

Working with governments to restore migratory birds and their habitats

Nicola Crockford
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Government involvement in conservation restoration works best when all share a common vision, even if the motivations differ between stakeholders. Hence policy advocacy works best when there is real understanding of the motivations of, and pressures on, government counterparts – and their bosses. How can delivery of what you know the birds need, also deliver for the decision makers? How can you convey the birds' needs in a manner that those decision makers can absorb? How can you jointly come up with a win-win vision that they embrace as their own? What tools facilitate this?

In most of the world, the sticks available for enforcing conservation restoration are very weak. Carrots work best, if they can be presented enticingly enough. Peer pressure is a vital tool in most cases.

This talk will explore these questions with reference to some examples, such as working with China to save the Yellow Sea coasts for birds like the spoon-billed sandpiper, implementing species action plans, stopping illegal killing of birds and working with the energy sector to minimize impacts on birds.

It will touch on how biologists can have greater impact in achieving conservation outcomes through partnerships and better targeting and communicating research. It will also consider how such approaches can be built into the Post-2020 biodiversity framework that is being negotiated this year, in terms of connectivity and international cooperation.

Nicola Crockford has worked for 28 years on species conservation for the RSPB at national, European and, for the past decade, global levels. She is RSPB Principle Policy Officer, and also policy lead for BirdLife International's Global Flyways Programme and its focal point for the Convention on Migratory Species and a range of other treaties for migratory bird

conservation. She works with governments around the world to get the best deal for migratory birds.

OFFERED ORAL PRESENTATION

Close order management of wader populations: the case for headstarting

Lynda Donaldson*, Rebecca Lee & Geoff M Hilton
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Close order management tools are critical amid a world of declining biodiversity and resulting small, remnant populations of species, where urgent actions are required for population persistence. Headstarting is a technique developed on chelonian species, whereby eggs are harvested from the wild and reared in captivity, before being released back into the population at a later life-stage. Ultimately, the aim is to improve demographic rates during a period to which population growth is most sensitive, and one in which captive-rearing is feasible. In this talk, we will discuss the benefits and challenges associated with this technique for managing small, isolated populations using the Eurasian Curlew (*Numenius arquata*) and Black-tailed Godwit (*Limosa limosa limosa*) in the UK as case-studies. Breeding populations of these species have suffered historic declines as a result of climate change, changes in agricultural practices, and increasing mesopredator abundance. In common with other waders, productivity is low, with high mortality during both the nest and chick-rearing periods. Age-structured stochastic population models showed that headstarting could boost population growth by increasing productivity up to ten-fold. In turn, this can buy critical time to understand impending threats to these species and implement the necessary conservation procedures, as well as accelerate recovery of very small populations once sites are in favourable condition.

The success of these projects to date for securing sustainable populations of these species will be discussed. We also consider the role of such close order management techniques in species conservation, and how such projects should be planned, monitored and integrated into wider population recovery plans.

Lynda Donaldson is a Senior Research Officer at the Wildfowl and Wetlands Trust, focusing on species recovery. She has broad interests in securing populations of threatened species over the long-term, preserving wetlands at the landscape-scale, and achieving practical conservation solutions.

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KEYNOTE

Decision Science for Population Reintroduction and Reinforcement

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Reintroduction and reinforcement are two predominant types of conservation translocation. Their use continues to increase and they are essential methods for recovering threatened species and ecosystems and as a component of rewilding. Yet, the success of these methods is not guaranteed. The rewards from conservation translocations will be maximised if good processes are followed. Undertaking any conservation translocation requires making a series of difficult decisions under uncertainty. These decisions will begin with whether a conservation translocation is the best method to achieve our objectives, what form it should take and what post-release support might be required. I will show how these decisions can be approached to provide the best possible conservation translocation outcomes. I encourage a values-focussed approach with an explicit treatment of uncertainty such that the science informs (but does not make) our decisions. In this sense science is critical but we need to know where it fits and how to use it. Through a series of examples from bird reintroductions including New Zealand hihi (*Notiomystis cincta*), Mauritius 'echo' parakeets (*Psittacula eques*) and Mauritius olive white-eye's (*Zosterops chloronothos*), along with reinforcements including hihi and Australian Regent Honeyeater (*Anthochaera phrygia*) and developing plans for assisted colonisation of Sihek (Guam Kingfisher, *Todiramphus cinnamominus*), I will show how science has helped inform conservation translocations and where our decisions remain difficult.

John Ewen's research focusses on reintroduction biology. He is a member of the IUCNs Conservation Translocation Specialist Group and coordinates their training for effective use of the Guidelines for Reintroductions and Other Conservation Translocations. John is co-chair of the Hihi Recovery Group, member of the BIAZA Reintroduction Advisory Group and is involved in many conservation translocation projects globally.

All presentations in alphabetical order by presenting author

POSTER

Informing local and landscape-scale management of a threatened wader population.

Harry Ewing[1*], Jennifer Smart[2], Samantha E. Franks[3], Niall H. K. Burton[3] & Jennifer A. Gill[1]

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In recent decades, many species of wader have declined in abundance and range across all major migratory flyways. Population declines have been particularly severe in species of large-bodied wader within the tribe Numeniini, including two species which may already be extinct and five which are classified as globally 'Endangered', 'Vulnerable' or 'Near Threatened'. To restore populations and prevent further extinctions within the tribe, implementation of local and landscape-scale conservation management is essential. To do this successfully, situations in which demographic rates can be boosted need to be identified so that conservation management can be tailored accordingly.

The Eurasian Curlew (*Numenius arquata*) is the UK's fastest declining Numeniini species, with the number of breeding pairs having decreased by 48% in the last 20 years. As a large-bodied species, curlew have a high adult survival rate however, curlew populations in the UK are generally thought to suffer from unsustainably low rates of breeding productivity and high rates of nest predation. Consequently, efforts to restore curlew populations in the UK are likely to require the use of tools designed to boost breeding productivity and studies investigating how to deploy these tools effectively.

To inform the deployment of conservation tools designed to boost curlew breeding productivity, field-based observations were used to investigate how demographic rates varied across a gradient of habitat and land management types, in Breckland; a large biogeographic region of eastern England where breeding curlew are still sufficiently abundant for this type of study to take place. The study aimed to identify situations in which breeding productivity needs boosting and also, situations in which breeding productivity is already high, so that the conditions promoting population stability or growth can be replicated elsewhere. This study will provide a strong foundation for targeted, evidence-based conservation of lowland breeding curlew populations, in the UK.

All presentations in alphabetical order by presenting author

Harry Ewing is an ornithologist focused on researching the applied ecology and conservation of breeding waders. He is currently undertaking a PhD at the University of East Anglia, on understanding how best to conserve lowland breeding curlew populations.

OFFERED ORAL PRESENTATION

Evaluating joint genetic and ecological approaches to restoring a threatened bird population

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Effective restoration and conservation of small threatened populations often requires mitigation of simultaneous genetic and ecological threats to population viability. However, the effects of independent versus simultaneous management of genetic and ecological threats on survival and reproduction are rarely quantified, hindering robust assessment of population-level consequences and conservation policy decisions. This situation is epitomised by the remaining Scottish Red-billed Chough (*Pyrrhocorax pyrrhocorax*) population, which is of major conservation concern. Demographic calculations revealed a critically small effective population size, implying that population reinforcement to alleviate inbreeding will be necessary to ensure population persistence. However, recent crashes in survival have been linked to poor food availability, implying that population reinforcement alone may not be enough to ensure population viability if habitat quality is insufficient to support introductions.

To fulfil their legal responsibility to maintain biodiversity, Scottish Natural Heritage funded a multi-year (2010-18) emergency supplementary feeding programme to alleviate ecological constraints on survival. Supplementary feeding is widely used to aid conservation of threatened populations, but existing evidence regarding its efficacy is still highly conflicting. We use intensive colour-ring resighting data to show that supplementary feeding successfully increased first-year survival. Further, we use before-after control-impact analyses of long-term demographic data to show that feeding stabilised breeding success against a background decline, and increased adult survival probability. Consequently, the supplementary feeding intervention alleviated multiple

major constraints on population growth rate, and substantially increased the probability of population persistence.

However, simulations show that even effective supplementary feeding may ultimately fail to ensure longer-term population restoration unless population reinforcements to alleviate inbreeding are also enacted.

This case study of science-informed conservation policy demonstrates that supplementary feeding, a widely used conservation tool, can have strongly beneficial conservation effects, and highlights that simultaneous mitigation of both ecological and genetic constraints may be vital to ensure successful population restoration.

Sarah Fenn is PhD student with broad interests in applied population ecology. She is particularly interested in the demographic and environmental drivers of population change, and how this can be applied to inform effective long-term conservation strategies.

OFFERED ORAL PRESENTATION

Land sparing for birds and multiple ecosystem services

Tom Finch[1]*, Brett Day[2], Simon Gillings[3], Dario Massimino[3], John Redhead[4], Rob Field[1], Andrew Balmford[5], Rhys Green[1,5] & Will Peach[1]

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Land is finite, yet demand is growing for the services it provides. Understanding how to allocate land for the sustainable delivery of multiple and often competing objectives is therefore a major societal challenge. In addition to nature conservation, natural or seminatural habitats have the potential to contribute to multiple environmental goals including carbon sequestration, water purification and recreation. In most regions, increasing the area of natural or seminatural habitat requires a reduction in the area of farmland which, in turn, implies an increase in production per unit area of farmland if demand for food is to be met.

Here, for two regions of lowland England, we use empirical data and predictive models to ask whether the environmental costs of producing more food per unit area from farmland are

compensated by the potential to create larger areas of natural and seminatural habitats (land sparing). For a suite of spatially-explicit land-sharing and land-sparing scenarios in The Fens and Salisbury Plain we predict outcomes for bird populations, global warming potential, diffuse pollution and outdoor recreation.

We show that land-sparing scenarios (i.e. those which produce more food from farmland whilst increasing the area of natural and seminatural habitat) can deliver multiple environmental benefits simultaneously. However, not all land-sparing scenarios resulted in multiple wins; environmental outcomes also depended on the spatial arrangement of natural or seminatural habitat, the types of natural or seminatural habitat promoted on spared land, and the overall regional food production target.

Tom Finch is interested in population ecology, land-use, agriculture and conservation. He works for the RSPB as a Conservation Scientist.

OFFERED ORAL PRESENTATION

Changes in social groups across reintroductions and effects on post-release survival

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Reintroductions, essential to many conservation programmes, disrupt both abiotic and social environments. Despite growing recognition that social connections in animals might alter survival (e.g. social transmission of foraging skills, or transmission of disease), there has thus far been little focus on the consequences of social disruption during reintroductions. Here we investigate if moving familiar social groups may help a threatened species to adjust to its new environment and increase post-release survival. For a reintroduction of 40 juvenile Hihi (*Notiomystis cincta*, a threatened New Zealand passerine), we observed social groups before and after translocation to

a new site and used social network analysis to study three levels of social change: overall group structure, network associations, and individual sociality. We also tested alternate translocation strategies where birds were kept either in familiar groups during holding, or in aviaries where their prior association was mixed. Although social structure remained similar among juveniles that remained at the source site, we detected significant changes at both the group- and individual- level post-release. Crucially, there was some tendency that translocated juveniles who gained more associates during re-assortment of social groups were more likely to survive their first year post-release. However, our holding treatments did not affect these social bonds so we remain unable to maintain or manipulate social groups during translocation. Nevertheless, we suggest that prior sociality may not be important during translocations, but rather individuals that are most able to adapt and form associations at a new site are most likely to be the surviving founders of reintroduced populations.

Victoria Franks is a zoologist with a main interest in understanding how we can predict animals' behavioural responses to changing environments. She is particularly interested in how we can apply such research to reintroductions, and how it can provide evidence that helps better inform translocation management of threatened species.

POSTER

Movement and migratory behaviour of released UK-bred White Stork (*Ciconia ciconia*) - monitoring the success of the reintroduction project

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The White Stork Project is a pioneering partnership of private landowners and nature conservation organisations, who are working together to restore a self-sustaining, free-living, breeding population of approximately 50 pairs of White Storks (*Ciconia ciconia*) in southern England by 2030 through phased releases over the next five years. Whilst hefted adult birds have been released in order to establish a sedentary population at Knepp, Sussex, the subsequent release of first year birds is considered to be a key requirement to encourage some migration within the population.

All presentations in alphabetical order by presenting author

For both the adult releases and captive breeding of juveniles for release, storks were sourced from eastern and western populations, leading to an artificial mixing between the two flyways. Additionally, the close proximity of breeding populations in continental Europe means that if Sussex juveniles cross the English Channel it is highly likely that they will soon encounter migratory flocks and potentially follow those instead. Tracking migration success and routes of the juveniles allows for monitoring the success of the reintroduction programme and understanding migration behaviours, therefore, high spatial and temporal resolution data on their movements was collected on eight of the 24 juveniles released by fitting Movetech Flyway-50 transmitters. This data can be used to determine home ranges, habitat choice, foraging strategies, and distance moved per day. Here we report on the initial year of monitoring and tracking UK captive-bred juvenile storks that were released in summer 2019. This reintroduction provides a novel opportunity to: determine the influence of heritable, social and environmental variables on the movement/migratory behaviour of the reintroduced birds; investigate the foraging and movement behaviour of the reintroduced storks; and to quantify causes of mortality and identify management measures that may enhance the success of the reintroduction programme.

Lucy Groves is a conservation biologist working on projects across Sussex with an interest in animal behaviour. As the White Stork Project Officer for Durrell, based at Knepp, Sussex, Lucy is responsible for post-release monitoring including feeding ecology and movement data, coordinating partner organisations and volunteers, and delivering public engagement.

POSTER

Research and Conservation efforts for the protection of endemic birds in Taita Hills cloud forest

Paul Gacheru[1*], Luca Borghesio[2], Lawrence Wagura[2], Kariuki Ndang'ang'a[3], Sarah Havery[4], Mwangi Githiru[5] & Paul Matiku[1]**

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The Taita Hills, an isolated massif rising up to 2,200m above the surrounding dry plains in south-eastern Kenya, is part of the Eastern Afromontane Biodiversity Hotspot. Three endemic birds

depend on the Taita Hills, the Endangered Taita White-eye *Zosterops silvanus,* and the Critically Endangered Taita Apalis *Apalis fuscigularis* and Taita Thrush *Turdus helleri*.

Taita's montane cloud forest habitat is now intensely fragmented, with c.98% of the original forest having been destroyed over the last 200 years. The remaining forest comprises 12 fragments ranging in size between 1–220 ha restricted to the highest peaks and steepest slopes, surrounded by a dense matrix of human settlements.

Through a partnership project, efforts are underway to protect and improve the cloud forest habitat while enhancing their connectivity for the threatened endemic species. The science-driven multi-tactic approach involves trials of various habitat restoration techniques, land lease and/or purchase, policy and advocacy, and research to understand the drivers of population trends for *A. fuscigularis* and *T. helleri*.

The achieved 25-years land lease and the ongoing land purchase efforts have already secured 9.25ha capable of providing habitats for c. 20 pairs of *A. fuscigularis.* More efforts are being put in land purchase targeting an additional 21ha to expand habitats and create an important habitat corridor between two fragments. However, the exercise is faced with challenges due to high land value and unwillingness to sell by many land owners. Trial habitat restoration plots with combined total size of c.8ha in two fragments have demonstrated a cost-effective approach and quick recovery of low natural vegetation which form ideal habitat for the species. We demonstrate the local-scale preparations required prior to scaling up restoration efforts, which in the long-term will protect Taita's unique biodiversity and provide water security and climate change mitigation to the local communities.

Paul Gacheru is a wildlife ecologist working as a program manager at Nature Kenya supporting forest landscape restoration initiatives across the country.

Luca Borghesio is a biologist with more than 20 years of experience working on bird conservation projects in in the forests of East Africa.

All presentations in alphabetical order by presenting author

OFFERED ORAL PRESENTATION

Multi-taxa consequences of restoring historic management within cultural landscapes

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Throughout Western Europe, many conservation efforts focus on semi-natural habitats shaped by a long history of human management. Here, conservation interventions often mimic perceived 'traditional' land-use practices and target at a few charismatic species that depend on the habitat. Systematic examination of species requirements at a landscape scale (biodiversity auditing), synthesised with an understanding of landscape history, emphasises the importance of historical land-use practices for regional biota; simply mimicking 'traditional' management may not restore the range and complexity of past conditions. To test whether restoring complex historical management enhances priority bird populations and other regional biota requires multi-taxa experiments.

Through a landscape-scale experiment across the UK's largest grass-heath, we examine the consequences of restoring this management (physically-disturbed grass-heath, varying in disturbance age and complexity) by implementing a large number of replicate plots and comparing responses to undisturbed controls. Responses were assessed for a bird species of conservation concern (Woodlark, *Lullula arborea*) and the richness of plants, spiders, beetles, true bugs and aculeates – sampling over 900 invertebrate and 200 plant species. Woodlark abundance increased through the study and was higher on the treatments compared to the controls; however, there was no benefit of complex historic management over an alternative ground disturbance treatment which lacked complexity. For invertebrates and plants, the restoration of historic management resulted in a considerable increase in species richness across taxa, including rare, scarce and threatened species. Interestingly, those species we predicted to increase from management, based on *a priori* examination of species requirements, responded best. Finally, we identify which treatments are optimum and explore how much management is needed to benefit these populations at a landscape-scale. Our experiment demonstrates the benefits of restoring historic management to cultural landscapes and emphases the value of integrating *a priori* knowledge of species requirements and land-use history into conservation planning.

All presentations in alphabetical order by presenting author

Robert Hawkes is a PhD student at the University of East Anglia, UK. His research investigates outcomes of management to support avian figurehead species for other diverse taxonomic groups (plants, beetles, true bugs, ants, bees, wasps and spiders), utilising one of the largest replicated landscape-scale experiments in Europe.

POSTER

Wetland size and open water matters: constructed agricultural wetlands as alternative breeding sites for boreal waterbirds

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The loss and degradation of natural wetlands by agriculture, forestry and other human activity, has caused declines in wetland dependent bird species worldwide. Constructed wetlands can provide alternative habitats for waterbirds and thus mitigate the negative effects of natural wetland loss. It is poorly known, however, what biological and physical characteristics of constructed wetlands are important for waterbirds.

We studied the relationship between constructed wetland characteristics and waterbird species diversity and habitat use at 31 constructed agricultural wetlands in boreal zone, Finland. We measured six environmental factors to find out which habitat characteristics of the constructed wetlands are the most important ones for waterbirds, especially for breeding and brood rearing waterfowl. We predicted that 1) the total area of the wetland, 2) open water area, 3) shoreline length, 4) average water depth, 5) number of different vegetation zones and 6) age of the wetland, would be associated with the species richness of all breeding waterbirds and waterfowl as well as the individual species detected breeding or brood rearing at the sites.

Our results show that the most important wetland characteristic explaining the species richness of all breeding species was the total size of the wetland. For waterfowl, the area of the open water was the most important environmental characteristic. According to a species-specific analysis, the total size of the wetland, the area of the open water and the shoreline length were the most important variables in determining species occurrence on the sites. Moreover, different species have different environmental requirements for breeding and brood rearing, and this should be taken into account in constructing and managing artificial wetlands in order to

maximize the biodiversity gains for waterbirds, especially waterfowl that breed mainly in boreal areas.

Ilona Helle is a PhD student in ecology studying the biodiversity of constructed wetlands from an ecological and socioeconomical point of view.

POSTER

Identifying and managing infertility in the critically endangered kākāpō

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The Kākāpō (*Strigops habroptilus*) is a critically endangered flightless parrot native to New Zealand that reproduces infrequently and has a high incidence of hatching failure (~70%). Kākāpō breeding is extremely unpredictable, driven by the abundance of fruit from masting species with irregular cycles. The 2019 breeding season was unprecedented: ecological conditions from late December 2018, including a record abundance of rimu fruit, induced record-breaking breeding rates. These unique circumstances provided a once-in-a-generation opportunity to obtain the sample sizes required to address crucial questions about kākāpō reproduction, including why their eggs fail and how this is influenced by variation in maternal investment and condition. Here, we will report how rates of fertility and embryo mortality vary across the kākāpō population and, for the first time, estimate the extent to which male infertility drives reproductive failure. In addition to their direct relevance for kākāpō conservation management, these findings will fundamentally improve our broader understanding of reproductive problems in endangered species.

Nicola Hemmings is a Royal Society Dorothy Hodgkin Research Fellow based in the Department of Animal & Plant Sciences, University of Sheffield. Her research interests lie in the reproductive behaviour and physiology of birds, and the applications of this field to conservation biology.

All presentations in alphabetical order by presenting author

POSTER

Research and action to restore breeding Common Scoters Melanitta nigra in west Inverness-shire, Scotland.

Geoff M Hilton [1]*, Ed Burrell [1], Henry Dobson [2], Mark Hancock [3], Larry Griffin [1], Andrew Low [4], Alison MacLennan [5], Carl Mitchell [1], Alastair Stephen [4] & Andrew Douse [6]

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Common Scoter *Melanitta nigra* is Red Listed in the UK with a population decline of almost 40% between 1995 and 2007. With fewer than 50 pairs remaining, there is a high risk of the scoter disappearing as a UK breeding species. Furthermore, there are now concerns that the species might be declining globally, with declines reported in the core population that winters in the Baltic.

Recent research by WWT, RSPB and SNH, aimed at identifying factors driving the decline, has led to a suite of conservation actions being delivered at key sites by partner organisations (including SSE and FLS) and the local community. Low numbers of broods appearing on lochs relative to the number of females present in the pre-breeding phase indicated high nest and duckling predation rates. Intensive studies of scoter activity and nest survival, involving the use of temperature loggers and custom-made cameras to determine nest fate, provided valuable information on ecology and habitat use. Colour-ringing of females enabled assessment of adult survival and reproductive rates, while females fitted with geolocators revealed the location and timing of movements in relation to wintering areas.

The research findings underpin a range of conservation interventions. Management of vegetation on natural islands at key sites is supplemented by the trialling of artificial islands to buffer water level fluctuations. The construction of an anti-predator fence in conjunction with diversionary feeding to deflect mammalian predator attention from one key nesting area is underway and will be monitored using trail cameras in addition to those at nest sites. At another location, detailed hydrological modelling was used to inform a revised water level management regime aimed at maintaining island integrity and minimising predator access during incubation, while providing shallow water foraging habitat during brood rearing. Consideration is also being given to headstarting to accelerate recovery. [299 words]

Geoff Hilton is the Head of Conservation Evidence at WWT, overseeing wide-ranging research to underpin the conservation of wetland nature. Previously he worked on the restoration of island endemics and seabirds. More recently he has worked on the recovery of Eurasian Crane, Spoon-billed Sandpiper, Greenland White-fronted Goose, Black-tailed Godwit and Eurasian Curlew.

OFFERED ORAL PRESENTATION

The ability of functional diversity metrics to measure different aspects of ecosystem functioning

Lisbeth Hordley[1]*, Simon Gillings[2], Owen Petchey[3], Joseph Tobias[4] & Tom Oliver[1]

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Functional diversity metrics aim to provide information on ecosystem functioning, but trait choice is critical. From ecological theory, we expect that a high diversity of response traits will lead to communities with greater resilience against environmental perturbations, whereas effect trait diversity will support communities to provide a higher mean level of functioning. However, it has not been investigated whether the combination of traits used in functional diversity metrics measure two different aspects of ecosystem functioning: stability and mean function level over time.

Here, we use Breeding Bird Survey data for 90 British birds from 1994-2018 to measure the mean and stability of two ecosystem functions, seed dispersal and pest control. Functional traits are split into either effect, response, or those that provide both, and combinations of these are used to calculate two functional diversity metrics (FD and FDis).

Seed dispersal effect trait diversity calculated using FD is positively correlated with the mean level of function and negatively related to stability as predicted. For both seed dispersal and pest control, response trait FD is positively related to stability, as predicted. However, functional diversity calculated using FDis shows contrasting results.

Overall, we show that the type of trait combinations included in functional diversity metrics influences which aspects of ecosystem functioning they predict – a finding that is highly relevant for the use of such metrics in ecosystem management. We also found that the choice of

functional diversity metric (e.g. FD versus FDis) appears to have an impact on the ecological conclusions drawn from functional diversity measures.

Lisbeth Morrison is a PhD student at the University of Reading with a main research focus on applied conservation and ecosystem functioning. She is particularly interested in using functional traits to understand the link between human-driven environmental changes and their impact on ecosystem functions and services.

OFFERED ORAL PRESENTATION

Evaluating created wetlands for birds, what is more important: environment, fish or amphibians?

Ineta Kačergytė[1*], Debora Arlt[1], Åke Berg[2], Michał Żmihorski[3], Tomas Pärt[1]

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During the last century wetland destruction, inflicted by urbanisation and agricultural drainage, has been estimated at 70 % which has led to wetland-related biodiversity loss. Luckily, many countries are promoting wetland restoration and creation to provide water habitat and increase biodiversity. However, evaluations of bird species in such interventions are largely lacking. We investigated whether bird community in Sweden´s created wetlands relates to habitat features of the wetlands (such as size or vegetation structure), their adjacent surroundings (e.g. grasslands, forest) and their landscape setting (e.g. in terms of forest, urban areas, and isolation). We investigated which wetland- and landscape- features were associated with habitat selection reflecting site attractiveness for birds and whether other features were associated with reproductive success.

Often such created systems may have introduced fish or have become colonized by amphibians, but the effect of fish and amphibians on bird communities is poorly known. We used environmental DNA to estimate species richness of fish and amphibians in 52 wetlands, investigating the effects of occurrence of fish and amphibian on bird communities and reproductive success. We discuss the results in terms of how to improve the biodiversity outcome when creating new wetlands in different landscape settings.

Ineta Kačergytė is a PhD student in landscape ecology and conservation research area, focusing mainly on wetland ecosystems. She is interested in how wetland creation and restoration affect

bird communities, and whether the conservation measures to restore aquatic habitat is successful for water related biodiversity.

OFFERED ORAL PRESENTATION

The effect of rush management on upland wader nest predation: an artificial nest experiment

Leah A. Kelly[1]*, David J.T. Douglas[2], Mike Shurmer[3] & Karl L. Evans[1]

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There is increasing concern regarding the decline of upland wader populations in the UK and much of Europe. Numerous factors probably contribute to these declines, although reduced habitat suitability due to rush invasion and low breeding success due to high nest predation rates are likely to be key factors in many cases. Rush management is a major component of conservation action that aims to bolster upland wader populations, especially for Eurasian Curlew *Numenius arquata.* Regular cutting of rushes to open up the sward is considered to improve both foraging and nest habitat, and has been associated with increased wader population sizes. Its impacts on breeding success are poorly understood, however, due to the difficulties of locating sufficient nest numbers across a range of habitat types.

We address this issue using an artificial nest experiment that compares survival rates of 184 nests in paired fields of rush pasture that are either untreated (control fields) or managed by rush cutting regimes following or emulating the EK4 and EL4 prescriptions in Entry Level Stewardship. We did so during the 2019 breeding season in two upland regions of England with variable predator control – the South West Peak and Geltsdale. Our initial results suggest that wader nests located in treatment fields have higher predation risk and enable us to assess the effectiveness of two common conservation practices (predator control and rush management) for reducing this risk. Recommendations and prescriptions for rush management must consider trade-offs between any increase in nest predation rates and the wider benefits of rush management.

Leah Kelly is a biologist with a main research focus on wildlife ecology and conservation, primarily concerning wading birds. She is predominantly interested in research where findings can be directly applied and used to inform on-the-ground conservation interventions.

POSTER

Recovery Trends of Three Endemic Bird Species in the Nominated World Natural Heritage Site "Northern Part of Okinawa Island"

Nobuhiko Kotaka [1], Katsuhi Nakata[2], Asako Miyamoto[3] & Tsutom Yagihashi[4]

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Endemic species that have evolved on an island environment tend to be vulnerable to the effects of alien species. Okinawa Island is located in the southwestern part of Japan, which is the largest island among the Endemic Bird Area (EBA) “Nansei Shoto” identified by Birdlife International. Three endemic bird species, Okinawa Woodpecker *Dendrocopos noguchii*, Okinawa Rail *Hypotaenidia okinawae*, and Okinawa Robin *Larvivora namiyei*, are distributed in the northern part of Okinawa Island. Here we introduce the results of the ongoing project to restore the endemic bird populations in the Northern Part of Okinawa Island.

The Japanese government and Okinawa Prefecture started the eradication project of the invasive alien species Small Indian Mongoose *Herpestes auropunctatus* in the Northern Part of Okinawa around 2000. As a result of thorough mongoose control measures, the number of mongooses caught declined around 2007, and then not only the Okinawa Rail but also the Okinawa Woodpecker and the Okinawa Robin, recovered significantly in the following 10 years. The progress of the mongoose countermeasures and the recovery of the three endemic bird species in northern Okinawa is a good example of contributing to the achievement of the Aichi target in 2020.

The Japanese government submitted the nomination document of “Amami-Oshima Island, Tokunoshima Island, the Northern Part of Okinawa Island, and Iriomote Island,” to UNESCO as a candidate for a World Natural Heritage in February 2019. In order to ensure the viability of endemic species populations at the Northern Part of Okinawa Island, it is necessary to establish future ecosystem management plans for the entire Okinawa Island.

All presentations in alphabetical order by presenting author

Nobuhiko Kotaka is a biologist with a main focus on wildlife ecology and conservation, mainly in island forest ecosystems. He is particularly interested in developing the ecosystem management plans for conservation of endangered endemic species in harmony with local community at "Nansei Shoto".

OFFERED ORAL PRESENTATION

Restoring cultural landscape towards wilderness may put both avian diversity and endemism at risk: a Tibetan case study

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Ecological restoration is becoming a primary strategy to increase provisions of ecosystem services and converse biodiversity losses. In cultural landscapes undergoing land use extensification, rewilding has been proposed as a viable approach to reverse biodiversity loss through reducing human impacts. The world's largest grassland restoration campaign is taking place on the eastern Qinghai-Tibetan Plateau (QTP) to reverse degradation and enhance the upper stream region's water retention capacity. However, little is known about if the large-scale rewilding also benefits the unique bird assemblage of the eastern QTP.
Our study aims to make science-based conservation recommendations for the Tibetan avifauna by detecting their diversity and endemism distribution patterns at the local scale. In the breeding seasons of 2014 and 2015, we carried out bird surveys and conducted a habitat mapping using three Unmanned Aerial Vehicles (UAVs). Our results indicate that the distributions of avian diversity, endemism and abundance are not congruent on the eastern QTP, calling for the conservation of different habitat types. Long-time human–nature interaction between Tibetan nomads and the alpine environment formed a complex vegetation structure. Vertical and horizontal habitat heterogeneity maintain the local bird diversity with anthropogenic elements significantly enriching the overall bird abundance. Degraded pastures provided key habitats for two high-abundant endemic passerines, i.e. the White-rumped Snowfinch *Onychostruthus taczanowskii* and the Ground Tit *Pseudopodoces humilis*.

Our results reveal that Tibetan cultural landscape maintains the structural heterogeneity needed to achieve multiple bird conservation objectives on the eastern QTP. Restoring the cultural

landscape into a "natural" tall-grass or dense-shrubland state may result in the loss of both high-abundance avian communities and endemic species diversity. Our empirical study also showed implications that rewilding abandoned agricultural landscape will not necessarily lead to a desired conservation outcome especially when the requirements of habitat specialists and endemics are not taken into account. Moreover, ecological restoration projects should evaluate the divergences between its ecosystem service and biodiversity objectives.

Li Li is an ecologists focusing on interactions of social–ecological systems, mainly in alpine grasslands. She has over ten years research experiences on the Tibetan Plateau. Using bird as the biodiversity indicator, she is currently studying the impacts of human land use on multiple facets of biodiversity, including taxonomic, phylogenetic, and functional diversities.

OFFERED ORAL PRESENTATION

Changes in the availability of the vulture-toxic drug diclofenac in South Asia and its impact on the recovery of three critically endangered Gyps vultures

John W. Mallord[1]*, Toby H. Galligan[1], Vibhu M. Prakash[2], Krishna P. Bhusal[3], ABM Alam[4], Richard G. Cuthbert[1] & Rhys E. Green[1,5]

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Three species of resident *Gyps* vulture underwent catastrophic population declines across their range in South Asia from the 1990s onwards, with a 99.9% reduction in the numbers of White-rumped Vultures, and 97% reduction of both Long-billed and Slender-billed Vultures. The cause of these declines was poisoning by the non-steroidal anti-inflammatory drug diclofenac, which proved to be toxic to vultures who fed on the carcasses of cattle recently treated with the drug. The sale of diclofenac for veterinary use was banned by the Government of India in 2006, followed shortly after by Nepal and Bangladesh, with further strengthening in 2015 when it became illegal to sell larger (i.e. 30 ml) vials intended for human use.

Since 2007, undercover surveys of pharmacies in India, Nepal and Bangladesh have been undertaken to assess the availability of diclofenac and other NSAIDs to farmers and veterinary practitioners. A local man was employed to tell the pharmacist he had a sick cow and to buy the

first drug that was offered to him. Although, there was a decrease in the sales of diclofenac across all three countries, disappearing from Nepal and Bangladesh, it continued to be widely available in India, accounting for 10-46% of sales across states in the latest surveys.

Vulture populations have been monitored by road transect surveys across India and Nepal, since 1992 and 2002, respectively. The rate of decline of vulture populations in both countries slowed after the initial ban of diclofenac in 2006, with evidence of a slight recovery after its later tightening, especially in Nepal, where diclofenac has all but disappeared from sale in pharmacies, illustrating that the ban has been successful. Although a positive story, threats remain: diclofenac is still widely available in India, and other NSAIDs also known to be toxic to vultures are increasing their market share.

John Mallord has worked at the RSPB for over 20 years, initially working on threatened species in the UK, before focussing on migrant birds in the non-breeding season in West Africa. Since 2018, he has led the RSPB's science work on the globally threatened *Gyps* vultures in South Asia.

POSTER

The re-introduction of the Great Bustard to the United Kindom

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Great Bustards are listed as vulnerable by the IUCN. They were originally native in the United Kingdom but became extinct in the mid-19th century. Hunting was thought to be the reason for extinction along with changes in farming practices and habitat loss in some areas. The Great Bustard re-introduction project was established in 1998, with the first birds being imported in 2004. It is the first and only project in the world to re-introduce this species or any species within the family Otitidae from a zero population.

The work of the project since its inception has been a huge learning curve in many ways. Habitats, breeding, behaviour, nutrition etc. have now been observed from a UK perspective. Information gathered has increased our knowledge of this species and the ability to re-introduce these birds into an altered environment.

The hand-rearing of chicks (while avoiding imprinting the on humans) as well as releasing them to free-living status on Salisbury Plain has had challenges with practical experiences being tested.

The omnivorous nature of this bird means that it can adapt to fluctuating levels of individual foods, taking advantage of different foodstuffs throughout the year dependant on availability. Working with landowners, conservationists and environmental schemes not only enhances the survivability of these birds but by implementing optimal habitat management it also benefits many other species. As a result, the numbers of Great Bustards inhabiting Southern England are increasing.

At present, this small population of 100 birds is on the cusp of self-sustainability. A typical social structure has been established, recently achieving a good level of breeding success with fledged "British" birds entering the population. As the predominantly young founder population matures in the coming years with more experienced breeding females, the prospect for a fully re-established Great Bustard population in the UK is insight.

Ruth Manvell is a biologist working for the Great Bustard Group with the main intent on establishing a self-sustaining and stable population of these birds in the UK. She is interested in animal health issues, having previously specialised in avian virology, in applying this knowledge in a conservation environment.

OFFERED ORAL PRESENTATION

Why do eggs fail? A review of hatching failure in managed wild and captive bird populations

Ashleigh F. Marshall[1,2]*, Francois Balloux[2], John Ewen[1], Gary Ward[3], Nicola Hemmings[4†] & Patricia Brekke[1†]

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Hatching failure is a ubiquitous phenomenon throughout all birds, affecting 10% of eggs on average. However, the rate of failure can be much higher in both wild and captive endangered populations, and this can represent a barrier to improving the reproductive success of individuals in conservation programmes. Previous research has suggested that the primary cause of hatching failure may vary between wild and captive endangered populations, with wild populations primarily experiencing hatching failure as a result of embryo mortality, while captive populations have a higher incidence of fertilisation failure. Such variation may impact the efficacy of different

management interventions aiming to mitigate hatching failure, which may not be designed to specifically target the factors leading to embryo morality and/or fertilisation failure. However, this prior research had some limitations, such as few populations and species being included and a lack of comparison between wild and captive populations of the same species.

Here we aim to test the generality of this observation by conducting a systematic literature review, including information from the 'grey literature' and several available unpublished datasets. Where possible, we investigate patterns of true fertilisation failure versus embryo mortality, compare hatching failure rates between different populations of the same species, identify the leading drivers of hatching failure, and determine the potential influence of different management interventions. This effort allows us to accurately characterise the rate of hatching failure in a large number of wild, managed wild, and captive bird populations, across a variety of species.

The results of this review will highlight the potential key factors leading to fertilisation failure and embryo mortality in managed bird populations. The patterns we characterise will inform management strategies that can be tested to reduce hatching failure, and hence maximise reproductive success of threatened species.

Ashleigh F. Marshall is a PhD researcher investigating the behavioural, environmental, and disease-related drivers of fertilisation failure and embryo mortality in managed wild and captive bird populations. Her aim is to deliver research that helps to support management decisions and improve reproductive success in conservation programmes.

OFFERED ORAL PRESENTATION

A structured approach to recovery planning for New Zealand's rarest breeding bird

Thalassa McMurdo Hamilton[1,2]*; Stefano Canessa[1,3]; Troy Makan[4]; Tim Blackburn[2]; John G. Ewen[1]

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Threatened species recovery is made challenging by a lack of clarity in the problems to be solved by groups of stakeholders, their competing management objectives and the diverse management

alternatives that might be proposed. These factors are compounded by uncertain outcomes of interventions for data-poor species and subjective attitudes towards the risk of action. Structured Decision Making (SDM) is a powerful process that works through these challenges, providing a framework to use appropriate scientific tools and allowing managers to make the best choice. Whilst SDM is widely used in resource management, its application to species recovery is rare.

We used SDM to assist the Tara iti Recovery Group to develop a recovery plan for New Zealand's (NZ) rarest breeding bird. Tara iti, or New Zealand Fairy Tern (*Sternula nereis davisae*), has a breeding population of approximately 10-12 pairs with little population growth over the last decade and no clear direction in what to do to promote population recovery. Working with multiple stakeholders, including the dual decision makers of NZ government and Māori (NZ's indigenous people), we structured a collaborative process, centred on identifying fundamental objectives of management and a range of management alternatives that could be used to achieve these objectives. Using available data and expert elicitation, we predicted the consequences of each alternative on each objective, including building a bespoke population model, and solved the optimal choice based on the decision-makers' values and risk attitudes.

Overall, the SDM provided a platform for dialogue between frequently opposed stakeholder groups, allowing all voices to be heard. Focussing on values first provided the required context to rationally develop and compare possible management alternatives, preventing decisions being driven by unclarified individual beliefs. Most powerfully, this allowed the decision makers to have the appropriate information to make an informed choice.

Thalassa McMurdo Hamilton is a conservation scientist with a research focus on the efficacy of conservation interventions, application of decision science to conservation problems and population modelling, predominantly for seabird conservation. She is particularly interested in techniques for overcoming the barriers that prevent conservation managers from making sustainable decisions.

POSTER

Restoring a top avian predator: reintroduction of White-tailed Sea Eagles to Ireland

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All presentations in alphabetical order by presenting author

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Translocations including species reintroduction, reinforcement or introduction have been used successfully to restore populations of species extirpated from all or part of their former range, to reinforce existing populations and, exceptionally, to introduce a species to areas outside its former range where conservation action is needed to prevent global extinction. White-tailed Eagles *Haliaeetus albicilla* were extirpated as a breeding species in Ireland in the early 20th century following population decline due to human persecution. Preparatory studies including population modelling, site selection and identification of a donor population, resulted in the initiation of a reintroduction programme in the Republic of Ireland. Between 2007 and 2011 one hundred young White-tailed Eagles (51 males and 49 females) were collected from nests in Norway under licence and released in Killarney National Park, SW Ireland. Wing-tags and radio and/or GPS satellite transmitters were attached to birds for individual identification and tracking post-release. Birds dispersed over much of the island of Ireland with at least six birds sighted or tracked to Scotland and one to northern England. First territories were established in 2010, first breeding efforts in 2012 with chicks fledged successfully in 2013. The number of territorial pairs increased rapidly but declined after 2014 with the loss of some adult birds. However, the number of breeding pairs and the number of young fledged continues to increase, with 26 young fledged to date. Comparison of population growth and breeding success with the first phase of the Scottish west coast Sea Eagle reintroduction (1975-85) suggests that the outlook for the Irish population is reasonably optimistic but may need supplementation. Illegal poisoning (58% of known mortalities) has had a serious impact on population growth and continues to threaten the viability of the reintroduction programme.

Allan Mee is a biologist with a life-long interest in endangered species biology and conservation. He has worked on species from waders to raptors including California condor recovery, managed the White-tailed Sea Eagle reintroduction in Ireland since 2007 and currently the EU Nature RaptorLIFE project in SW Ireland.

OFFERED ORAL PRESENTATION

Evidence of flexibility and positive responses to habitat change in the European nightjar *Caprimulgus europaeus*

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Restoration of habitat often revolves around physical land management, which may impact on species use of a habitat by altering how animals can meet their needs. Habitat change may impact individuals within a population differently and understanding how this individual variation contributes to the population mean is important when developing conservation strategies. For example, high individual variation may indicate a generalist and flexible population that is resilient to environmental change, but individuals themselves may in fact be specialised. Evidence of this variation can be collected using GPS tracking devices that can identify movement and habitat use of multiple individuals within a population. Here we have tracked 41 European nightjars, over four years of habitat change that occurred as part of a peatland restoration project on the Humberhead Peatlands NNR, UK. We calculated individual habitat selection measures and analysed home range size change in line with changes in habitat availability to understand functional trade-offs made by the birds

Individual variation was high and explained more than variation between years. The population contained specialist individuals, with strong selection for single habitat types, and generalist individuals that used multiple habitat types more evenly. However, functional relationships did not vary significantly between individuals. Across the population, home range size decreased as the availability of cleared habitat increased, but as the amount of open water increased, home range size also increased. High individual variation in habitat choice shows that the population is flexible and that a mosaic of different habitat types should be provided. Changes in home range size do however demonstrate that some habitats may be more valuable than others. Our results demonstrate the importance of using measures of habitat selection and functional responses at the individual level, rather than a mean value, to produce more informative conservation measures.

Lucy Mitchell is an applied avian ecologist, particularly interested in collecting data on space use, movement and energetics to create evidence-based management options for species conservation. She has a range of experience in tracking birds using GPS and VHF, spatial analysis using R, metabarcoding and survival analysis.

All presentations in alphabetical order by presenting author

OFFERED ORAL PRESENTATION

Lessons from a conservation icon: contrasting fortunes of four reintroduced populations of the Mauritius Kestrel

Malcolm Nicoll[1], Carl Jones[2,3], Sion Henshaw[2], Vikash Tatayah[2] & Ken Norris[1].

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Reintroduction is now a commonly used approach for the conservation of threatened avian species, but recovery trajectories can vary considerably between programmes, and the causes of success or failure are often unclear. The IUCN/SSC Reintroduction Specialist Group's (RSG) guidelines provide a comprehensive 'step by step' approach to facilitate the design, implementation, monitoring, review and assessment of a reintroduction. However, the latter three steps are frequently cited as lacking in reintroduction programmes, which not only limits our understanding of programme-specific conservation outcomes, but also our ability to learn from these outcomes and improve subsequent avian reintroduction efforts.

One of the earliest conservation avian reintroduction programmes, initiated in the early 1980s, was for the (then) Critically Endangered Mauritius kestrel and over 10 years 331 captive-reared kestrels were released into 4 isolated sub-populations. Using data from short-term, island-wide surveys and >25-year population-specific, long-term monitoring programmes we show that these four sub-populations have very different recovery trajectories, including local extinction, recent decline and comparative stability. We explore the demographic reasons behind these differences and illustrate how previously overlooked population limiting factors are responsible for the recent population decline. We also show how the resulting evidence can guide management recommendations, particularly reintroduction efforts that are currently being implemented.

This assessment of a long-term reintroduction programme provides valuable insights into the merits of post-release monitoring and highlights the challenges associated with identifying and mitigating for the drivers of rarity in threatened avian species in a constantly changing environment.

Malcolm Nicoll is a conservation biologist with a focus on the recovery and management of small populations, principally in tropical island systems. His research combines both population ecology and movement ecology to generate evidence which guides the recovery programmes for a range of threatened bird species.

POSTER

Identifying species' pools for indicator species selection

Enya O'Reilly[1], Simon Butler[1], Lynn Dicks[1] & Richard Gregory[2]

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Multi-species indicators are embedded in environmental management, sustainable development and biodiversity conservation policy and practice, acting as metrics against which progress towards national, regional and global targets are measured. The choice of species included in an indicator has a defining influence on how well it reflects ecosystem condition, the speed and extent to which it responds to environmental change and the confidence intervals around its metric value. When choosing species to act as informative indicators, approaches often rely on expert opinion or data availability; generally applicable and objective methods for species' selection are frequently lacking. We endeavour to address this issue by employing an objective measure of species' relative habitat use (RHU) to define the pool of species from which an indicator set can be drawn.

Taking the development of a European Forest Bird indicator as a model system, we use Pan-European Common Bird Monitoring Scheme (PECBMS) data to quantify RHU for a suite of European breeding birds and quantifying reliance on forest habitats accordingly. We explore regional variation in RHU, variation in RHU dependent on forest density within sites and discuss the implications for defining the pool of species from which a forest indicator set should be drawn. Finally, we demonstrate how this process can be combined with an existing indicator species selection protocol to construct a European Forest Indicator. Integrating these approaches provides us with an effective protocol for informative indicator species selection which is of growing demand from policy makers and stakeholders for greater consistency and standardisation in species selection.

Enya O'Reilly is a UEA PhD student focusing on population dynamics and ecosystem functioning. She is interested in species' interactions with environmental change and human intervention. The focus of her PhD is developing an informative and objective method for indicator species selection to better inform conservation practice and influence policy.

All presentations in alphabetical order by presenting author

OFFERED ORAL PRESENTATION

Regent Honeyeater conservation breeding program: The influence of zoo-based life experience on post-release fitness

Benjamin Pitcher[1]*, Joy Tripovich[1, 2], Gordana Popovic[2], Dean Ingwersen[3] & Andrew Elphinstone[1]

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The Regent Honeyeater (*Anthochaera phrygia*) is a critically endangered bird. The wild population size is estimated at 350-400 mature individuals. The main threats to the species include its small population size, habitat loss fragmentation and degradation, and competition. The species is currently ranked in the top 10 Australian birds, most likely to become extinct over the next 20 years.

The Taronga Conservation Society is playing an important role in the Regent Honeyeater species recovery program. The conservation breeding program is now a crucial part of the National Recovery Plan (2016) with one of the aims of the plan is "to bolster the wild population with zoo-bred birds until the wild population becomes self-sustaining'.

In total since 2008, 294 birds have been released to the wild in NSW and Victoria in five release events. All releases involve intensive monitoring of released birds by a large group of volunteers, and the post-release monitoring team provides regular updates on the number of Regent Honeyeaters sighted, made up of released and wild birds.

The aim of the current study is to better understand how husbandry practices influence post-release success and ultimately manage the zoo based population to produce birds that are superior release candidates.

Data on the zoo life experience of birds was collected from husbandry and health records and genetic information. Post-release data included re-sighting and nesting success data. Life experience indicators focused on six main areas: experience in multi-species aviaries; sex, weight, morphometric measurements; health status of released birds; genetic history of birds and their parents; age of birds at release; and prior breeding experience before release into the wild. This presentation will discuss the influences of husbandry on survival and reproduction and the implications for management of conservation breeding programs.

All presentations in alphabetical order by presenting author

Benjamin Pitcher is a behavioural ecologist and leader of the Conservation Behaviour Lab at Taronga Conservation Society Australia. His interests include how animals forage and communicate in complex and changing environments. His current research focusses on behavioural adaptation and management tools and translating behavioural research into conservation and welfare outcomes.

POSTER

European Turtle Dove: mapping spatial use and habitat preferences to inform landscape management measures

Susana Requena[1], Alison Beresford[1], Graeme Buchanan[1], John Mallord[1], Chris Orsman[1], Juliet Vickery[1], Cyril Eraud[2], Hervé Lormée[2]

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The European Turtle Dove (*Streptopelia turtur*) is a globally-threatened species that has experienced a population decline across Europe of nearly 80% since the 190s' and has been listed by the IUCN as Vulnerable since 2015. In common with other migratory land birds, there are likely to be multiple causes of this decline including the habitat degradation on both the breeding and wintering grounds and unsustainable hunting. Consequently, greater understanding of the habitat preferences of this species is essential to implement landscape management and restoration measures to reverse this decline.

We aim to build a complete picture of the species' habitat associations throughout the year, and along the entire migratory flyway incorporating tracking data from 34 PTT tagged birds, from which 14 birds provided 30 full migration journeys, along with remotely-sensed environmental and field-collected data from breeding, wintering and stopover sites. Tagged birds, both in the UK and France, spend on average 54% of their annual cycle in Africa, 30% in Europe and 16% on migration. Non-breeding grounds were distributed across floodplains in Senegal, Gambia, Mali and Mauritania.

Combining tracking data with remotely-sensed environmental variables and field observations, we aim to develop species distribution models and map potentially suitable habitat for turtle-doves across the western Sahel. Preliminary analysis suggests the importance of the triad of trees and thorny bushes for roosting, a source of water, and natural grasslands and cultivated land for

food. This information, combined with international collaboration along the flyway, will be key in implementing in-situ conservation measures where and when they are needed.

Susana Requena is a biologist with a main research focus on spatial conservation planning of habitats and species. She is particularly interested in spatial ecology, geographical methods and mapping to provide appropriate scientific information to policy and decision makers.

OFFERED ORAL PRESENTATION

Using time travelling mud (palaeolimnology) as a tool to underpin waterbird conservation and restoration

Hannah J. Robson[1,2,3], Geoff M. Hilton[2], Vivienne J. Jones [1], Stephen J. Brooks[3], Carl D. Sayer[1], Carole Roberts[1], Georgina Charnley[1], Lilian Unger[1], Jan C. Axmacher[1], Maarten van Hardenbroek[4], Andrew Douse[5] & Eileen Rees[2]

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Diagnosing causes of decline and identifying restoration targets is fundamental to species recovery. A common approach in decline diagnosis is to make comparisons of between environmental conditions at sites where a species currently persists and those from which it has been lost. However, this approach rests on the risky assumption that contemporary site-differences reflect an optimal habitat state or persisting drivers of historic decline. Here we use three case-studies to show how evidence from lake sediment cores (palaeolimnology) brings a historic perspective to underpin waterbird restoration.

While rapid environmental change in the high arctic breeding grounds may be a driver of Bewick's Swan decline, long-term data that could show the nature and consequence of environmental change in the region is lacking. We used sediment cores to explore how freshwaters in the Pechora Delta has changed over the last 200 years, and the implications of this for breeding swans.

Madagascar pochard - formerly widespread on the Madagascan plateau - now persists at a single, remote lake complex. As is typical of such situations, the remaining site is probably atypical of historic habitat, but due to ubiquitous wetland degradation elsewhere, it is difficult to identify

restoration target conditions. Palaeolimnology is being used to fill gaps in long term data and set restoration targets.

The Flow Country in northern Scotland is the key breeding site for the declining Common scoter. Contemporary spatial comparisons suggested that scoter decline might be associated with decline in macroinvertebrate food availability. Using multiproxy palaeolimnology, we were able to show a general increase in lake productivity and invertebrate abundance in recent decades, coincident with widespread catchment afforestation, suggesting that food limitation is an unlikely driver of decline.
We use these case studies to discuss the application of paleoecology to species restoration, and the future directions offered by new technologies.

Hannah Robson is a wetland scientist with a background in freshwater entomology, water quality analysis and palaeolimnology. Her research focuses on the use of innovative, cross-disciplinary approaches to assess recent environmental change in relation to the restoration of rare and/or declining water bird populations.

OFFERED ORAL PRESENTATION

A review of reintroductions of raptors in Europe: the importance of innovative techniques and post-reintroduction monitoring

Staffan Roos[1, 2], Alex Sansom[1], Ian Newton[3] & Jeremy D. Wilson[1]

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Species conservation often focus on protecting land, restoring certain habitat types and eliminating species-specific threats. However, when a species has been extirpated or declined to critically low numbers, reintroduction and reinforcement is often necessary to restore viable populations. Because of historical persecution and indirect poisoning, many raptors have declined or gone extinct in large parts of Europe, and reintroduction/reinforcement programs have been initiated to restore at least 15 different species of owls and diurnal raptors in Europe. Here we give a brief overview of these reintroductions, and explore the factors associated with varying outcomes, and discuss case studies of contrasting examples. The importance of innovative techniques (e.g. hacking, supplementary feeding and partnership working to reduce mortality caused by e.g. electrocution) as well as long-term post-reintroduction monitoring were some of the factors underlying successful reintroductions. Overall, this review suggests that for

raptors, population recovery cannot rely entirely on habitat and ecosystem restoration, but direct and sustained species-specific intervention, such as reintroductions, are likely to be needed.

Staffan Roos is a conservation scientist working on projects involving raptors, predation and conservation conflicts. Much of his work involves data from citizen science project, and he is interested in how such data can be used for conservation purposes.

KEYNOTE

Challenges and approaches for reestablishing and expanding birds on Guam in the face of invasive Brown Treesnakes

Julie A. Savidge* & Thomas F. Seibert
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Invasive snakes can severely impact ecosystems and disrupt natural ecological processes. The accidental introduction of Brown Treesnakes to Guam and subsequent loss of most native terrestrial vertebrates, including the majority of native forest birds, is a well-known example of the devastation that can ensue. Factors that contributed to the success of this nocturnal predator include its broad diet, ability to forage at various heights as well as employ a unique climbing technique, and the presence of abundant exotic prey. Advances in control methods for Brown Treesnakes have piqued enthusiasm for reintroducing birds to Guam; although these tools are encouraging, they have limitations. Our efforts protecting nests of Micronesian Starlings, an important seed disperser and one of two native forest avian species that have survived, suggest the range of this species could possibly be expanded using protected nest structures. To understand potential impacts of Brown Treesnakes on remaining birds, we investigated reproductive success of Micronesian Starlings (cavity nesters) and the distribution of Yellow Bitterns (open cup nesters) in relation to snake relative abundance. Building on this work and the known natural history of species previously occupying Guam, we discuss strategies for avian reintroductions along with challenges including poor fledgling success even in areas where snakes have been suppressed. Lastly, we discuss some unique challenges endangered Guam Micronesian Kingfishers present for reestablishment on Guam.

Julie Savidge is an Emeritus Professor in conservation biology at Colorado State University. Her early research identified exotic Brown Treesnakes as the cause of drastic avian declines and extirpations on Guam. Since then, as part of a cooperative project with the Invasive Species Science branch of USGS, her lab has studied the biology and control of this species. Her most recent research has focused on how to accomplish avian restoration on Guam.

All presentations in alphabetical order by presenting author

OFFERED ORAL PRESENTATION

Restoring farmland bird populations through landscape-scale restoration: Predicting the extent of agri-environment provision needed to reverse population declines of farmland birds in England.

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Agri-environment schemes (AES) aim to reverse widespread declines of farmland birds, but it is unclear how much AES provision is enough to achieve this. Our study quantified how the extent of AES provision has affected Population Growth Rates (PGRs) of conservation priority farmland bird species and asked: (1) How have AES affected PGRs of farmland bird species? (2) What proportion of the populations of farmland bird species need to be under AES to stabilise PGRs? The level of AES provision was defined according to the density of bird-friendly options provided through previous AES in three contrasting regions of England (UK): Arable East Anglia (EA), the mixed farming landscape of Oxfordshire (OX) and the grass-dominated West-Midlands (WM). We used data on changes in bird abundance and AES provision during the period 2008-17 from 70 higher level scheme (HLS) farms and 652 Breeding Bird Survey (BBS) 1-km squares. PGRs of 20 farmland bird species, and the composite Farmland Bird Index (FBI) were compared across three levels of bird-friendly AES: HLS provision (averaging 10% of the farmed area), 'entry-level scheme' provision (averaging 2.4% of the farmed area; ELS) and no bird-friendly AES provision. Overall, 13 out of 20 species responded positively to AES, 5 species showed no effect, and 2 species showed a negative response (to ELS level management in a single region). Initial estimates of AES coverage needed for future schemes varied between species and regions but were most consistent for the FBI. In the absence of any ELS-level provision, to stabilise populations the proportion of FBI species required to be exposed to HLS-level provision was 38%. Therefore, we suggest that future AES scheme design should aim to stabilise or increase populations of farmland bird species by ensuring that at least 38% of farms are subject to HLS-level bird friendly AES options.

Elwyn Sharps completed his PhD thesis "The effects of saltmarsh conservation grazing on breeding Common Redshank" at Bangor University in 2015. He is a Conservation Scientist for the

RSPB and has focussed on both seabirds and farmland birds. He is also the Publicity Officer for the International Wader Study Group.

OFFERED ORAL PRESENTATION

Saving Black-tailed Godwits in the UK through predator management and head-starting

Jennifer Smart[1*], Mark Whiffin[1], Helen Jones[1], Natalia Zielonka[1], Nigel Butcher[1], Hannah Ward[2], Charlie Kitchin[2], Lynda Donaldson[3], Geoff Hilton[3], Rebecca Lee[3] & Nicola Hiscock[3]

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There are now fewer than 50 pairs of Black-tailed Godwits *Limosa limosa limosa* breeding in the UK with around 90% of the population in the Fens in eastern England. Most of the population breed at one site, the Nene Washes, where low breeding success driven by high predation, has caused the population to decline. Project Godwit, a five-year partnership between the RSPB and the Wildfowl and Wetlands Trust funded by EU LIFE, aims to secure the future of black-tailed godwits as a breeding species in the UK.

Project Godwit has two key objectives: 1) to improve breeding success at the Nene Washes by using multiple methods of predator management to reduce the impacts of key predators and 2) to trial the use of head-starting, where chicks are reared in captivity and released once fledged, which could boost breeding success and fast track colonisation of grassland sites on the Ouse Wash that have been created for godwits.

Three years into this programme of conservation interventions, this presentation will review the progress we have made towards improving the fortunes of this nationally important breeding population of Black-tailed Godwits.

Jen Smart is Head of Species at RSPB England having previously worked for the RSPB Centre for Conservation Science where she specialised on breeding waders and conservation solutions to reverse their population declines. Her current role is about ensuring the RSPB is delivering the correct conservation actions in the right places for their priority species.

All presentations in alphabetical order by presenting author

POSTER

Effects of increasing tree cover along the urban-rural gradient on avian assemblages in Bangkok, Thailand

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South-east Asia is one of the world's most rapidly urbanising regions, for example Bangkok's population has grown from 6.4 million in 2000 to 10.4 million in 2019 with resultant urban expansion substantially reducing vegetation cover. Whilst it is well established that avian species richness is lower in highly urbanised locations the answers to two key questions remain equivocal. First, in temperate regions and at fine spatial scales avian species richness tends to peak at intermediate levels of urbanisation. This pattern is attributed to higher habitat diversity in these sub-urban regions, but it is unclear if such patterns arise in tropical regions. Second, the extent to which habitat restoration in urban areas can promote higher species richness is uncertain. Whilst many bird species are highly mobile and can colonise distant habitat patches colonisation potential may be reduced by surrounding intensively urbanised land, and habitat quality in such patches may be lowered by pressures from the surrounding urban matrix. Here, we assess spatial patterns in avian species richness and the composition of avian assemblages along an urban to rural gradient throughout the Bangkok region using repeated point count data (visited 3 times during March to July 2018) from 150 1 km x 1 km cells selected using random stratification across the gradient. In each cell, point counts were conducted in a randomly selected location and within the largest available patch of woodland or trees. We contrast avian assemblages in these two locations along the urban-rural gradient to provide a proxy of the potential for increasing urban tree-cover to enhance avian communities. Over 150 bird species were detected across all survey points. Avian diversity in woodland patches was consistently higher than in randomized locations. Although bird species richness declines linearly with increasing urbanisation intensity, the beneficial impacts of woodland patches appear to be maintained across the urbanisation gradient. Urban avian diversity will thus be adversely impacted by urban development but there is considerable potential to mitigate these impacts by increasing tree densities within urban green-spaces.

Phakhawat Thaweepworadej is a PhD student at Department of Animal and Plant Sciences, the University of Sheffield, focusing on the impact of urbanisation on biodiversity (especially birds and mammals) and ecosystem services.

All presentations in alphabetical order by presenting author

KEYNOTE

The role of birds in ecosystem restoration: ecological functions, networks and interactions

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Birds play a prominent role in a wide range of ecological functions, some of which are crucial for ecosystem resilience and restoration. Pollination, seed dispersal and insect predation by birds, for example, can theoretically accelerate reforestation in degraded or fragmented habitats. However, few studies have quantified the contribution of birds to the maintenance and restoration of functioning ecosystems, particularly at broader spatial scales. I will summarise evidence for the importance of avian trophic interactions in promoting ecosystem restoration with a particular focus on recent analyses based on avian functional traits. Results indicate that changes in land-use and climate may substantially impair the provision of ecological services by birds, and suggest that trait-based analyses can help to reframe conservation priorities with the goal of conserving and restoring ecosystem functions.

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

POSTER

Recovery planning for an extinct-in-the-wild species, the Sihek (Guam Kingfisher, *Todiramphus cinnamominus*)

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Successful species recovery planning needs to account for multiple stakeholder objectives and high potential uncertainty around outcomes, leading to variable risk tolerances. These problems are compounded for extinct-in-the-wild species, in particular when threats still exist in the species' native range. Then, it is imperative to understand the dynamics of the captive population to ensure harvests for release are sustainable. Additionally, there is uncertainty over the fitness of captive-bred individuals when released at alternative wild release sites and, where assisted colonisations to areas outside the species' native range are considered, potential impacts on release site ecosystems.

We are using a structured decision-making approach to plan re-establishment of wild populations of Sihek (Guam Kingfisher *Todiramphus cinnamominus*). Potential release sites include reintroduction to Guam and assisted colonisations outside the Sihek's native range. Stakeholder-identified fundamental objectives include minimizing global extinction risk and maximising viability of released populations, but also minimizing impacts on release-site ecosystems. We built an individual based model to assess future viability of both the captive population under alternative harvest regimes and wild populations at alternative release sites. We used a novel approach to assess the potential for impacts from Sihek releases to occur through different mechanisms at alternative release sites, using expert elicitation and following the Environmental Impact Classification for Alien Taxa framework. A key expert-identified potential impact mechanism was predation, which we therefore further assessed for each site using the newly developed Invader Relative Impact Potential metric. We thereby predicted the consequences of alternative translocation strategies on the joint objectives of increasing Sihek population viability and minimizing ecosystem impacts, to inform rational decision-making. Our work provides a template for use where there are uncertain outcomes in species recovery that potentially result in highly variable risk tolerances, both in terms of focal-species extinction risk and potential impacts on native ecosystems.

Amanda Trask is a conservation biologist and population ecologist at the Zoological Society of London. Her main research interests are in the demographics and genetics of small, threatened populations and in the use of conservation translocations in species recovery planning.

All presentations in alphabetical order by presenting author

POSTER

Modelling the impacts of scenarios of land use change on farmland and woodland bird indicators.

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There is increasing pressure on British agricultural systems to meet demands of a growing population whilst minimising environmental impacts. The Achieving Sustainable Agriculture Systems (ASSIST) programme aims to address this issue by investigating "sustainable intensification": developing agricultural systems that simultaneously increase the efficiency of food production and improve environmental quality. To meet these goals, it is important to understand current agricultural practices, how these vary across Great Britain and how these may change in the future. The ASSIST Scenario Exploration Tool (ASSET) allows exploration of current and future land cover and use scenarios and their impacts on socio-ecological factors across Great Britain.

This study's aim was to model predicted output metrics for farmland and woodland bird indicators across all scenarios, including newly-developed likely future drivers of environmental change: afforestation and grassland management intensity.

The study utilised existing and newly-developed spatial data, incorporating the Land Cover Map (2015), CEH Land Cover® plus Crops, scenarios of afforestation and grassland intensity, climate data (January and July temperature, rainfall year) and modelled bird coefficients from BTO/JNCC/RSPB Breeding Bird Surveys. ASSET baseline and scenario rasters were reclassified according to crop and grassland intensity. Bird abundance was modelled as a function of baseline land cover and climate data. Model coefficients were then used to predict bird abundances under each scenario. Individual farmland and woodland bird indicator species results were grouped according to indicator and the geometric mean for each group of modelled results was calculated, in accordance with BTO's processing of indicator species.

This resulted in over 10,000 unique rasters of bird indicator responses to land use scenarios. These responses will be fed into ASSET, complementing existing output metrics. This will enable ASSET to continue to contribute to policy maker and stakeholder engagement, and improving our understanding of land use intensification impacts on key environmental outcomes.

All presentations in alphabetical order by presenting author

Emily Upcott is a Spatial Ecology Research Associate at the Centre for Ecology & Hydrology. She uses spatial methods to address ecological questions, particularly relating to sustainable agriculture. She has a background in GIS, Conservation Science and Ecology, having previously worked in raptor-wader conflicts, riparian ecology and habitat restoration.

OFFERED ORAL PRESENTATION

Overcoming behavioural Allee effects in avian reintroductions: the case of the Puerto Rican parrot (*Amazona vittata*) in the El Yunque rainforest

Thomas H. White, Jr.*, Wilfredo Abreu, Gabriel Benitez, Arelis Jhonson, Limary Ramirez, Iris Rodriguez & Jafet Velez
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Reintroductions and translocations have increasingly become key strategies in restoring extirpated or locally extinct populations. This is particularly true with critically endangered avian species, some of which have recently existed only in captive populations, or in numbers so low in the wild as to impede normal social interactions and population dynamics. Such has been the case with the last relict wild population of the Puerto Rican parrot in the El Yunque rainforest. A long-term program of systematic releases of captive-reared parrots into the relict wild population with the goal of stabilization and subsequent growth of the wild population began in 2000, and continues to date. However, during most of the earlier years of the release program, substantial increases in the wild population proved elusive, despite relatively high post-release survival of released birds. This was largely due to poor integration of released parrots into the small, low-density wild population – a common phenomenon with releases of highly social animals into low-density recipient populations. Thus, during 2015-2017, we implemented a new release strategy designed to overcome this apparent behavioural Allee effect. To do so we: 1) released large groups (20-24) of parrots annually at the same release site, 2) implemented methods to maximize site fidelity and flock cohesion, and 3) fostered the "reverse integration" of the wild parrots into the larger established release flock, rather than vice versa. This strategy resulted in not only integration of both the wild and released parrots into the same social flock, but also an over 500% increase in total population (from 10-13 in early 2015 to 53-56 in late 2017). Released captive-reared parrots also began acquiring the "wild dialect" in vocalizations within 6 months of release, and successfully reproduced during each year following release. Our reintroduction strategy has potential application for other highly social species.

Thomas White is a Wildlife Biologist with the USFWS-Puerto Rican Parrot Recovery Program, where he has worked for the past 20 years. During this time, he has also worked towards the

conservation of other Neotropical psittacines throughout the Caribbean and in Central and South America.

POSTER

Quantifying threats to biodiversity and prioritizing responses: a case study from Papua New Guinea

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Accurately identifying threats to global biodiversity is the first step towards effectively countering or ameliorating them. However, such threats are usually only qualitatively categorized, without any comparative quantitative assessment of threat levels either within or across ecosystems. This can lead to generalized conservation responses that lack targeted specificity, thereby reducing both their efficiency and effectiveness. As part of recent efforts by the Government of Papua New Guinea and United States Aid to International Development (USAID) to develop a long-term strategic plan for reducing threats to biodiversity at the national level, we developed a novel and quantitative methodology for not only assessing relative effects of specific biodiversity threats across multiple ecosystems, but also identifying and prioritizing conservation actions best suited for countering the identified threats. To do so, we used a combination of an abbreviated quantitative SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis together with multivariate cluster analysis to identify the most significant threats to biodiversity at the national level in Papua New Guinea. Of 27 specific threats identified, there were nine major threats (each >5% of total) which accounted for approximately 72% of the total quantified biodiversity threat in Papua New Guinea. Importantly, the major threats (n=7) shared across multiple ecosystems also accounted for 57% of the total biodiversity threat. We then used this information to identify specific actions targeting the underlying crosscutting threat drivers that would have the greatest probability of reducing adverse effects of biodiversity threats across multiple ecosystems. We categorized recommended conservation actions within three strategic categories; with actions within each strategic category targeting two different spatial scales. To our knowledge, this

integrated quantitative approach to identifying and addressing biodiversity threats has not previously been reported. Analyses of this nature can be invaluable for avoiding not only wasted resources, but also ineffective measures for conserving biodiversity.

Thomas White is a Wildlife Biologist with the USFWS-Puerto Rican Parrot Recovery Program, where he has worked for the past 20 years. During this time, he has also worked towards the conservation of other Neotropical psittacines throughout the Caribbean and in Central and South America.

OFFERED ORAL PRESENTATION

Restoring peatlands delivers bird population and wider ecosystem benefits

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Peatland restoration is internationally recognised for reversing effects of peatland degradation. Whilst much restoration is aimed at restoring water and carbon storage functioning, peatlands support important wildlife including birds that are expected to benefit from restoration. However, knowledge of bird responses is currently poor. We systematically reviewed the available literature to identify how birds respond to peatland restoration in temperate areas globally.

The review found that bird population responses may be dramatic and rapid, with marked abundance responses within 10 years and transformation of breeding bird communities in less than 20 years in cases where restoration is associated with change of land use. Bird responses often include increases in species of conservation concern, including those associated with wetlands, which globally are habitats that have suffered a high degree of conversion and fragmentation by agriculture and urban development.

Focussing on one study in more detail as a case study of restoration of upland water catchments in the UK, we examined the factors associated with bird responses. Over 9 years, restoration measures included grazing reduction, drain blocking, bog vegetation inoculation, conifer removal, native woodland planting and scrape creation. Of 18 bird species with sufficient data for analysis, restoration measures were associated with consistently positive population responses for five (European Golden Plover *Pluvialis apricaria*, Dunlin *Calidris alpina*, Eurasian Curlew *Numenius*

arquata, Skylark *Alauda arvensis* and White-throated Dipper *Cinclus cinclus*) and consistently negative effects for only one (Meadow Pipit *Anthus pratensis*). Dipper response was associated with the overall package of restoration measures; management to raise water tables was associated with positive responses by Golden Plover, Curlew and Skylark, whilst bare peat revegetation was associated with positive responses by Dunlin and Curlew and a negative response by Meadow Pipit. Monitoring of breeding bird responses should be considered for evaluation of all landscape-scale peatland restoration interventions.

Nick Wilkinson works on a range of applied ecological projects including avian responses to peatland restoration, work on farmland birds and detailed demographic studies of the response of twite to recovery measures.

OFFERED ORAL PRESENTATION

Ongoing efforts to save the critically endangered Liben Lark Heteromirafra archeri in Ethiopia

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The critically endangered Liben Lark *Heteromirafra archeri* is known from only two small grasslands in Ethiopia: the Liben Plain in southern Ethiopia and near Jijiga, c600km to the north-east (an area with significant security issues). The Liben Plain supports over 10,000 pastoralists with usufruct property rights, but has suffered from rangeland degradation through overgrazing, scrub encroachment, and conversion to crops, exacerbated by an increasing number of permanent settlements and the effects of severe drought.
A Darwin project was established on the Liben Plain in 2015, until March 2019. Using participatory rangeland management, the project worked to build capacity of the local pastoralists to create more sustainable livelihoods while restoring the grasslands and improving the habitat for the Liben Lark, through the creation of four communally managed grassland reserves (kallos). The kallos were managed by pastoralist communities to provide fodder for cattle during the dry seasons. However, the project was affected by a combination of political instability and the impacts of a severe drought over two years, 2015 to 2017.

On the Liben Plain numbers have declined since the first comprehensive survey in 2007, when 67 territories were found along 20 established transects, and the population estimated at 90-256 adults. A survey in June 2019 found just 13 territories on the transects, but most noticeable was that the kallos had fallen into disrepair in a short period.
To have a chance of saving the Liben Lark, the grassland in the area where birds were found in 2019 should be restored, by restoring the kallos and reducing grazing pressure, at least during the spring and autumn rainy seasons. At the same time, we need to understand why the kallos have not worked, through interviews with Liben Plain pastoralists, and to find a sustainable way to manage and restore the Liben Plain grasslands.

Simon Wotton is a Senior Conservation Scientist at the RSPB Centre for Conservation Science and is involved with single species surveys and large-scale monitoring projects, in the UK and in Africa

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