



# Joint conference of the Waterbird Society and the International Wader Study Group, Wilhelmshaven, Germany, September 2013

The joint 37th annual meeting of the Waterbird Society and the annual conference of the International Wader Study Group took place in the German port of Wilhelmshaven between 24 and 30 September 2013. Lasting a full week, it was one of the largest and longest conferences of its kind that has ever taken place. An aggregate of 307 delegates attended for at least part of the time; 179 delegates attended the WbS meeting, 179 delegates attended the IWSG conference (51 attended both). The formal sessions of the conference took place in Wilhelmshaven's comfortable and commodious Stadthalle. Accommodations were many and various, ranging from high-class hotels to the rather more spartan delights of the 1943 houseboat 'Arcona'.

With usually two and sometimes three parallel sessions, the organization, especially the timing of the conference had to be rigorous – and it was! From the tyranny of the one minute of very loud 'tern music' that divided the talks, to the excellent catering arrangements, the variety of the excursions and the vibrancy of the social events, the organization of the conference was excellent. All who attended are very grateful to those responsible.

With so many delegates, running the excursions must have been a nightmare, but for those who took part it was a great day out; moreover there were options to suit all tastes: the island of Helgoland, the East Frisian island of Langeoog, a mudflat hike to the island of Minsener Oog and a bus tour around the Jade Bight.

The Waterbird Society meeting was organized by the Institute of Avian Research 'Vogelwarte Helgoland' in cooperation with The Wadden Sea National Park Authority of Lower Saxony and the Landscape Ecology Group, University of Oldenburg with the support and sponsorship of the German Research Foundation DFG, Carl Zeiss Sports Optics, the Common Wadden Sea Secretariat, IBL Umweltplanung, Sparkasse Wilhelmshaven and RIFCON. The local organizing committee consisted of Peter H. Becker (chair), Christina Bauch, Jochen Dierschke, Anke Meinardus, Gregor Scheiffarth, Elke Schmidt, Lesley Szostek, Marco Wassmann, Sandra Bowhuis, Nadine Knipping and Heike Wemhoff; the scientific committee comprised Susan Elbin (chair), Peter H. Becker, Gregor Scheiffarth and Chip Weseloh.

The International Wader Study Group conference was organized by The Wadden Sea National Park Authority of Lower Saxony, Landscape Ecology Group, University of Oldenburg and Institute of Avian Research 'Vogelwarte Helgoland' with the support and sponsorship of Umweltstiftung Weser Ems, Carl Zeiss Sports Optics, the Common Wadden Sea Secretariat, IBL Umweltplanung and RIFCON. The local organizing committee consisted of Gregor Scheiffarth, Nadine Knipping, Michael Exo and Jutta Leyrer; the scientific committee comprised Jutta Leyrer, Nathan Senner, Yvonne Verkuil and Gregor Scheiffarth.

The following supported the joint conference: the Environment Ministry of Lower Saxony, Bahlsen, Jaques' Wein-Depot, Jever Brauerei, the City of Wilhelmshaven (free bus tickets for every participant!), Wadden Sea World Heritage Visitor Centre and Woodpecker Art Studio.

For the Waterbird Society meeting, social events started with a Welcome and a Poster Reception, both with free drinks and ended with a formal banquet on the Saturday. The formal

opening of the conference comprised many official speeches and music by the group 'Schlagwerk Nordwest' (fantastic drummers!). The International Wader Study Group conference started with a marvellous presentation on the first ever wader expedition to Mauritania by Jim Wilson on the houseboat 'Arcona'; there was a social evening on the Saturday at the cultural centre 'Pumpwerk' with the band Off Limits, on the Sunday there was a cultural 'Frisian Night' with a documentary on wet grassland bird protection entitled 'From Father to Son', and later there was music by Kleefstra, Pruiksma, Kleefstra. This took place in the UNESCO Wadden Sea world heritage visitor centre.

Altogether this was a most worthwhile, memorable and enjoyable conference!

**The joint WbS/IWGS conference was attended by 307 delegates from 30 countries**

	WbS only	IWGS only	Both	Total
Australia		3	3	6
Belgium	1	1		2
Canada	7	1	1	9
Czech Republic		6		6
Denmark	2	2		4
Estonia		7		7
Finland		1		1
France	3	3		6
Germany	34	31	20	85
Ghana			1	1
Hungary	1			1
Iceland		2		2
Ireland		1		1
Latvia	1			1
México	1			1
New Zealand			1	1
Norway	1	1		2
Philippines	1			1
Poland	7	2	1	10
Portugal	3	1	1	5
Republic of Korea	2		1	3
Russia	2	4	2	8
Spain	8	4		12
Switzerland		1	1	2
The Netherlands	4	29	5	38
Turkey	1		1	2
UK	6	23	7	36
Ukraine	1			1
United Arab Emirates		1		1
USA	42	4	6	52
<b>Total participants</b>	<b>128</b>	<b>128</b>	<b>51</b>	<b>307</b>
<b>Total countries</b>	<b>20</b>	<b>21</b>	<b>14</b>	<b>30</b>



# 37th Annual Meeting of The Waterbird Society

## Abstracts

### Plenaries

#### Beyond aggregate life history trajectories: insight from a 35-year study on Kittiwakes

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The growing richness of data collected in ongoing long-term longitudinal studies from marked wild vertebrates in conjunction with theoretical and technical progress in statistical tools have led to a progressive upgrade in the biological questions that can be addressed. Many early efforts have focused on evaluation of the relationship between biological or environmental factors (sex, habitat features) and the diversity of life history trajectories and lifetime production in populations, or the description of age-specific life history traits, mostly within the theoretical framework of trade-offs between traits. Subsequently, the significance of such studies has often been devalued in the literature because experimentation is assumed to allow stronger inferences about the processes underlying life history evolution. Experimentation is impossible in retrospective studies or undesirable in ongoing studies that have to maintain consistency in observations. However, the lack of insight on the representativeness of conditions created in experimental studies and in short-term studies in general has led to awareness of the limitations of such studies. Contemporary studies are benefiting from the call from other areas of research for tests of theories in quantitative genetics, population ecology and population dynamics using long-term non-experimental data. Here we adopt a 'historical' perspective on a 35-year study of Kittiwakes *Rissa tridactyla* conducted in Brittany (France) and analyze the changes in the questions about the evolution of life histories driven by new observations and changes in analytical tools. In particular we detail the input from other disciplines also addressing longitudinal data, our progression towards model-based inferences about individual fitness, and the use of conceptual constructs developed in other areas to account for the diversity of individual 'responses' (e.g. survival in life history studies). Analyzing long-term longitudinal data with a high degree of stratification according to individual and environmental features raises specific difficulties in terms of statistical inference. We address the new challenges we have to take up to address seemingly old questions raised in early studies of life histories of wild vertebrates.

#### The Wadden Sea Flyway Initiative – linking critical sites along the East Atlantic Flyway

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In 2009 UNESCO placed the Dutch-German Wadden Sea on the World Heritage List recognising its crucial importance for migratory birds on a global scale. Both countries now have enhanced responsibility to strengthen cooperation with other countries to conserve migratory birds; the Danish Wadden Sea applies for World Heritage status in 2014. The Wadden Sea Flyway Initiative (WSFI) was launched in 2012 to put this responsibility into action. Its draft vision is that "migratory birds find lasting refuge along the East Atlantic Flyway from northern breeding areas to their key Wadden Sea stopover and to the African coastline, and inspire and connect people for future generations". This vision reflects the inter-dependence of migratory waterbirds on critical sites of the East Atlantic Flyway – a key migration route with a chain of coastal wetlands. The situation however is not healthy: of 34 waterbird species monitored in the Wadden Sea, 16 are in decline. The West African ratio may be worse, though trends are not so well known, and data reliability and network engagement variable. This imbalance provides a strong rationale for the WSFI, and two projects began in 2012 aiming to increase capacity for migratory bird conservation and monitoring in western Africa. Activities include regional and national training courses, provision of equipment, network development and field monitoring, through the support and engagement of local organisations in partnership with a regional BirdLife International project. Developments are also underway to strengthen direct collaboration between sites, e.g. between the Trilateral Wadden Sea Cooperation and Mauritania's Banc d'Arguin, which supports among the highest concentrations of migratory waders in the world, many of which also depend on the Wadden Sea. Exchange instruments can foster lasting affiliations and benefit partner sites through increased awareness and capacity, joint monitoring activities and improved management of shared species.



## Seasonal interactions in migratory birds: individual-based drivers and population-scale patterns

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In migratory species, seasonal interactions between the conditions that individuals experience at different parts of the annual cycle can strongly influence individual fitness, as the effects of conditions in one season can be exacerbated, or reduced, by conditions experienced elsewhere in the range. Consequently, seasonal interactions in migratory birds can have important consequences for population-level processes, such as population growth, distribution and range expansion potential. Understanding seasonal interactions and their impact on population processes requires tracking of individuals across the migratory range, alongside identification of the factors influencing the initiation and maintenance of seasonal interactions. Using a long-term study of Icelandic black-tailed godwits, in which marked individuals are tracked by a network of >2000 volunteers throughout Europe, I will explore (1) the influence of migratory connectivity and seasonal interactions on individual fitness, (2) the mechanisms through which migratory connectivity is established and maintained and (3) the implications of migratory connectivity for population-scale processes and phenological responses to climate change.

## Migratory behaviour in Atlantic Shearwaters and Petrels: species-specific, population and individual strategies

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Tracking studies are revealing a hitherto unrecognized variability in seabird migration strategies and its different components, such as the timing, duration, route, stopover localities and final destination at non-breeding sites. However, little is known about how migration strategies change at species, population and individual level; in particular, how the variability of these components is apportioned within and among individuals, mainly due to the difficulty of obtaining repeated journeys by the same individuals. Here we analyzed the variability in migration strategies from species to individuals, and the individual repeatability in the timing of migration and the non-breeding areas in birds tracked with geolocators from two to five consecutive years from the following species: Great Shearwaters *Puffinus gravis*, Manx Shearwaters *Puffinus puffinus*, Cory's Shearwaters *Calonectris borealis*, Scopoli's Shearwaters *Calonectris diomedea*, Cape Verde Shearwaters *Calonectris edwardsii*, Bulwer's Petrels *Bulweria bulwerii* and Boyd's Shearwater *Puffinus boydi*. Our results are consistent with the hypothesis that species wintering close to the breeding grounds better track the environmental conditions of the year. Individual consistency in migratory strategies varied greatly among species from a low consistency (e.g. Bulwer's Petrel) to relatively high (e.g. Cape Verde Shearwater). In general, we found that most variability in migratory behaviour is mainly due to variation among individuals rather than within individuals. The timing of post-breeding migration was less consistent than the pre-breeding migration. These results provide the first insight into how widespread is the variability in the migration strategies and its individual

consistency among shearwaters and petrels. Nevertheless, further research is needed to understand the links among individual strategies, environmental variability, fitness, population dynamics and the evolution of the migratory strategies.

## From egg to senescence: long-term studies of Common Terns

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This plenary address will present an overview of my long-term (1970–2010) studies of Common Terns *Sterna hirundo* in Buzzards Bay, Massachusetts, USA. During the 1970s I worked mainly on breeding biology and factors influencing breeding success, with a focus on egg characteristics and chick growth. I started ringing large numbers of chicks in 1975 and by 1990 I had built up large numbers of ringed birds of known age. During the 1990s I was able to conduct intensive studies of known-aged birds, concentrating on demography, testing predictions of life-history theory, and exploring relationships between physiology and life-history. This led to several studies in 1995–2005 of manifestations and mechanisms of senescence. Simultaneously, I conducted parallel studies on Roseate Terns nesting on the same islands. Since 2006 I have worked on tracking terns with geolocators and I have started a new project studying the consequences of a genetic bottleneck in Common Terns at Bermuda. All this work was facilitated by collaborations with many academic biologists and their students, and has been reported in more than 100 papers in scientific journals, as well as several reviews and reports. Our research in Buzzards Bay was integrated with a conservation programme, and numbers of Common Terns increased from 400 pairs at one site in 1975 to almost 7,000 pairs at three sites in 2009.

## Research and conservation in Antarctic Seabirds

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Until recently, the temporal and spatial migration patterns of Southern skuas were almost unknown. We equipped adult South Polar Skuas *Stercorarius maccormicki* with geolocators at King George Island in the Maritime Antarctic. Three-quarters of them migrated to the Northern Atlantic, and a quarter to the Pacific Ocean. All birds showed a figure-of-eight flight pattern. The data for Brown Skuas *Stercorarius antarcticus lonnbergi* provides a different picture: their overwintering areas are in the South Atlantic near the Patagonian continental shelf, between the Falkland Islands and Uruguay. New miniaturized GPS-systems allowed tracking individuals at a very fine temporal and spatial scale. We employed GPS-loggers on the two skua species and tracked foraging flights. The Brown Skua fed mainly on penguins partly in rookeries at inaccessible islands, while the South Polar Skua fed offshore. We monitored the three penguin species that breed sympatrically on Ardley Island for more than 30 years. High breeding pair numbers were recorded for Gentoo Penguins *Pygoscelis papua*. In contrast, the lowest numbers of breeding pairs were counted in the case of Chinstrap Penguins *P. antarctica* and Adélie Penguins *P. adeliae*. Probable causes are the continuing warming of the climate in the Western Peninsula Region and the associated

reduction in winter sea ice expansion, which is itself connected with the development of krill, the main food source for Adélie and Chinstrap Penguins. The known breeding sites of the Light-mantled Sooty Albatross *Phoebastria palpebrata* are restricted to Islands in sub-Antarctic latitudes. In the season 2008/2009 we discovered a new breeding colony at Fildes Peninsula, King

George Island, South Shetland Islands, Antarctic (62°12'S, 59°01'W). The new breeding colony of Lightmantled Sooty Albatross represents the southernmost breeding place of any albatross species ever recorded. Finally we will show examples for endangered Antarctic seabirds and their protection.

## Symposium: Population Ecology of Terns

### Population ecology of terns: From life history to demography

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Terns *Sternidae* are small, elegant seabirds whose fascinating lifestyles are defined by strong time and energy limits. Terns are widely distributed from tropical to arctic areas, migrating over long-distances, and many species are endangered by manifold factors. This makes terns attractive for waterbird biologists interested in conservation and ecological research, even if investigations can be challenging. New methods of marking, tracking, automatic recording, sampling and statistics have been utilized in recent studies of some tern species, which as a group, are among the best studied birds in the wild. This diversity of research findings has secured a predominant place for terns in recent important findings in ornithology. For example, longitudinal, individual-based data have given insights into the mechanisms of age-dependent change, and current demographic modeling has increased our understanding of population regulation in terns. These types of life-history based approaches form an important foundation for effective conservation planning. This symposium aims to present an overview of recent studies and findings that advance our knowledge of tern life-history and ecology over multiple scales: from hormones, to age and mate effects on reproductive performance, via demography (e.g. survivorship, recruitment, philopatry, site fidelity, post-breeding dispersal and immigration) and finally to using terns as bio-indicators of environmental health. We hope that the presentations will stimulate discussion and future research.

### Novel findings from a six-year study: First estimates of adult survival for Great Lakes Common Terns and insights into recruitment

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Historically, multiple, long-term studies have laid the groundwork for our present understanding of the ecology, life-history and demography of Common Terns. Currently, establishing long-term research is expensive, problematic (given the short duration of most grants) and, in the case of well-studied species, may be viewed as unnecessary duplication. In 2008, we embarked on a long-term study of Common Terns at Presqu'île Provincial Park, ON to address unexplained population declines in the North American Great Lakes. Far from duplication, here we discuss the important novel findings for this species that

have resulted from the first six years of this ongoing study. These include: (i) the first adult survival estimates for Common Terns in the Great Lakes from a five-year mark-recapture project that will help inform conservation efforts; (ii) the first confirmed record of breeding by a one-year old Common Tern world-wide; (iii) previously-unreported growth patterns for Common Tern chicks; and (iv) preference for nesting in tall vegetation that is at odds with accepted management practices for this species. We argue that establishing long-term studies has as much value today as it ever has and that even the earliest stages of this research can produce important novel contributions for extensively-studied species.

### Immigration as the main factor driving species expansion – the case of the Whiskered Tern *Chlidonias hybrida* in Poland

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Range expansion is a phenomenon of considerable importance for every species. Birds comprise a group of animals in which a large number of species can easily travel long distances and choose suitable habitats for colonization. The expansion of the Whiskered Tern *Chlidonias hybrida* was studied in Poland over the last four decades. During the 1960s–1980s the Whiskered Tern bred in Poland sporadically, and the population was still small until the early 1990s. It has rapidly increased from 40 to over 1,600 breeding pairs during the years 1990–2007. On average, 42% of annually breeding Whiskered Terns bred in the Upper Vistula Valley. The observed average annual rate of population growth in both the whole of Poland and in the Upper Vistula Valley was the same: 0.25. The population growth rate expected in the absence of immigration was 0.16 for both areas; this explained approximately 33% of the observed growth in Poland and as little as 6% in the Upper Vistula Valley. This indicates that the increase in numbers must have been driven largely by immigration. A majority of breeding pairs bred in man-made water bodies, mainly in dam reservoirs and in carp ponds. Colonization started in the south-east and proceeded towards the north-west. This, coupled with the strong increase in population size in western Ukraine, suggests that immigrant birds most likely originated from there. The additional factors favoring quick colonization of Poland by Whiskered Tern include high availability of suitable breeding sites, the wide

flexibility with respect to breeding habitat choice, high availability of food and good breeding success in the Upper Vistula Valley, and an apparent lack of competition by other *Chlidonias* species. It also seems likely that shifts in both breeding and wintering ranges westwards could add to the strong population increases in Eastern Europe.

### Correlates of breeding site tenacity and productivity for Common Terns nesting on the North Channel of Lake Huron

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While breeding site fidelity is generally thought to be high for the Common Tern *Sterna hirundo*, there is evidence of high rates of turnover for breeding sites in the Laurentian Great Lakes. The objectives of this study were to: (i) determine the ecological factors affecting site fidelity and breeding success in this species and, thereby, (ii) identify the appropriate scales for monitoring and conservation efforts. During 2008–2013, we surveyed Common Tern breeding colonies on northern Lake Huron, and recorded the number of nests in June to assess site tenacity. There was considerable inter-annual variation in site use, despite similar maximum annual nest counts (range = 2,734 to 3,542; mean±SD=3072±389). The number of active sites each year ranged from 10 to 28 (mean=22±8). Of the 50 sites occupied during the study, 31 (62%) were used once and abandoned, 6 (12%) were occupied in two years, 7 (14%) were occupied in three years and 6 (12%) were occupied each year of the study. 12% of these sites were abandoned and then re-occupied in subsequent years. During 2010–2012, we also enclosed 10–30, 3-egg clutches at each of 3–5 colonies per year, and collected data on: egg size, hatching success, chick morphology and nestling survival to 21 d. Nestling survival to 21 d was relatively low in all years and there was a high degree of inter-colony variability (brood size at 21 d – 2010: mean=0.08, range=0–0.22 per site; 2011: mean=0.25±0.61, range=0–1.40 per site; 2012: mean=0.5±0.9, range=0–1.0 per site). The apparent causes of egg and chick loss were related to weather/storm surge at some sites and predation at others. The observed low site tenacity and poor breeding success may have important implications for population dynamics in this region. We will present additional results for 2013 and assess the ability of occupancy models (incorporating habitat and weather variables) to predict breeding success, site use and colony persistence in this species.

### How philopatric are Common Terns?

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Natal and breeding site fidelity are usually assumed to be high among Common Terns *Sterna hirundo* and other colonial seabirds. I summarize banding data from Pettit Island and other small saltmarsh islands in Barnegat Bay, New Jersey, USA, and review estimates of philopatry and dispersal at other Common Tern colonies in North America and Europe. As commonly reported previously, dispersal away from the natal site is more

common than dispersal from a breeding site. However, there is considerable variation among colonies, ranging from high breeding site fidelity at the well-studied colonies in New England and Germany, to high turnover among sites in the Great Lakes. The situation in Barnegat Bay may be intermediate to these two extremes, with site occupancy largely stable from year to year, but with frequent movement of individuals among sites. I examine possible explanations for variation in site fidelity, including colony size, prior reproductive success, and the frequency of disturbance such as flooding, and also consider potential biases in estimating dispersal rates.

### Insights into the processes driving reproduction success in the Common Tern

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In a monogamous species such as the Common Tern *Sterna hirundo* two partners contribute to the breeding process. How are partners chosen? Does pair bond play a role for reproductive performance? Is there an additional effect of age? Do males and females show different patterns? Is there heterogeneity between individuals? We use a detailed dataset of a long-lived seabird, the Common Tern, marked with automatically read transponders, to address these questions and thus gain insight into the reproductive pattern of this species. To handle missing information and model the complicated processes driving reproduction we used a hierarchical Bayesian model of the steps that lead to the number of fledglings, which includes processes operating at the individual level and the pair level.

### The regulatory effect of hormones during the reproductive and life cycle of terns

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Reproduction in birds is largely controlled by hormones because they mediate the trade-off between investment in self-maintenance and offspring, and furthermore, they link individual state with environmental conditions and adapt behavior accordingly. Corticosterone, the main avian glucocorticoid, rises immediately under stressful conditions. Slightly increased baseline levels are linked to higher activity and energy mobilization but a continuously maintained stress level leads to nest abandonment. This is attended by lowered prolactin, a hormone linked to parental care. Our literature research concerning hormones in Common Terns showed that age or breeding experience of marked and followed individuals were found to be tightly linked to hormones: Inexperienced individuals showed low baseline prolactin levels, accompanied by low breeding success, indicating their reduced investment/ability. Prolactin and corticosterone stress levels could act as mechanisms to adapt reproductive investment with age: older Common Terns exhibited

reduced corticosterone and increased prolactin stress values compared to younger birds, accompanied by high reproductive success. This suggests that old birds are less responsive to stressors and less likely to reduce parental care in stressful situations. Parental roles were also indicated by corticosterone: the higher foraging effort of fathers was mirrored by increased baseline corticosterone, especially after hatching. Body mass of Common Terns is another parameter influencing hormones and ultimately triggering parental behavior: if it deteriorates due to low food availability prolactin decreases and corticosterone increases leading to lower nest attendance. Furthermore, heavy individuals exhibit a more robust stress response than lighter ones.

### **Out of (colony) site, but not out of sight: Recent research on Roseate Terns at staging sites in Massachusetts**

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Although there is much evidence to suggest that the most important factors limiting recovery of the endangered Northwest Atlantic breeding population of Roseate Terns *Sterna dougallii* (ROST) probably are acting when the ROSTs are *not* at their colony sites, until recently, there has been relatively little research conducted during the post-breeding dispersal period (PDP) from mid-July through September. In 2005, we began expanding the colony site work being done on the USGS's Cooperative Roseate Tern Metapopulation Project to learn more about the distribution and behavior of ROSTs at staging sites in the 'Cape Cod & Islands' area of Massachusetts (hereafter CCMA). As our PDP research efforts grew over the next five years, we discovered that virtually all Hatch Year (HY) ROSTs and their care-giving parents from throughout the entire breeding range in the northeastern US and Canada were coming to CCMA. In 2011, we began using plastic field-readable (PFR) bands at seven colony sites from Connecticut to Nova Scotia that allowed us to identify individuals at up to 50 m, more than twice the distance of the metal FR bands used since 1992. Because we now can get multiple identifications of individuals with PFR bands easily, work done in 2011–2012 suggested that, before they leave North America, some HY ROSTs may be spending as much (if not more?) time at CCMA as they do after hatching at their respective colony sites. In the 2012 PDP, we resighted more than 75% of the ROSTs that received PFR bands that year. Also, of 164 HYs with PFRs seen at the staging sites in 2011, two returned to CCMA as 1-year-olds in 2012 but apparently did not visit any breeding colony sites. Results from the 2013 PDP research that will be presented are expected to provide new information on how many nonbreeding one- and two-year-olds return north, and what percentage of them do and do not visit any colony sites.

### **Terns as health indicators for the pelagic realm**

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There is an increasing demand to develop policy-relevant indicators for the marine environment. As specialized piscivores with wide ranges, terns are potentially useful as environmental indicators for the North Sea. Here we evaluate the utility of employing Common and Sandwich Terns as bio-indicators using a long-term dataset of standardized measurements (diet composition, body-condition of adults and chicks and breeding parameters) gathered in the colony of Zeebrugge, Belgium. Clutch size is an excellent candidate to serve as a health indicator because it is easy to monitor. However, hatching success was highly variable due to predation and flooding, and we found no link between clutch size and reproductive success for either species. Chick survival was a good proxy for reproductive success in both species. Apparently, chick survival is less affected by predation than hatching success and thus more directly linked to the prevailing food situation. Chick body condition was strongly linked to survival, suggesting that the availability and quality of forage fish is a decisive factor. In Zeebrugge, changes in the terns' productivity appear to be driven by fluctuations in clupeid availability. Data on diet composition and breeding parameters suggests that adult Common Terns (but not Sandwich Terns) adjust clutch size to the availability of clupeids. The proportion of clupeids in the faeces of adult Sandwich Terns (serving as a proxy for herring availability in May) also correlated well with chick survival, but in contrast to earlier studies, the proportion of clupeids in the chick diet was not related to survival. Despite high clupeid proportions in some years, specific prey sizes crucial for early growth were missing in the diet of the Zeebrugge Sandwich Terns resulting in high chick mortality. This suggests that not only the timing of clupeid arrival in the coastal waters but also length distribution of this forage fish are key factors for the survival of tern chicks.

### **Immigration and local recruitment as drivers of population growth in a Common Tern colony**

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Immigration is known to be an important factor in population growth, but is often hard to quantify. We estimated annual immigration into a colony of Common Terns *Sterna hirundo* marked with transponders over a 19-year period, using a Bayesian integrated population model that links colony size and productivity with individual life histories. In order to identify what attracted immigrants to the colony in some years more than others, we correlated the number of immigrants to various proxies for environmental quality, specifically number of local sub-adults and local recruits, colony size (conspecific attraction) and breeding success (public information). Numbers of local recruits and local sub-adults showed strong positive correlations with number of immigrants. We found that variation in

immigration rate had strongly contributed to variation of colony growth rate, more than variation in local recruitment or adult survival. By comparing laying dates of immigrant and local breeders, we approximated the proportion of first-time breeders among immigrants. Results suggest that immigrants are mainly inexperienced birds that were attracted by the presence of local recruits and sub-adults.

### Annual adult survival estimates for Black Tern populations in the United States and the Netherlands

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The Black Tern *Chlidonias niger* breeds in freshwater wetlands in the Northern Hemisphere. The North American subspecies *C. n. surinamensis* has experienced declines in many U.S. states and Canadian provinces, while the Netherlands population of the Eurasian subspecies *C. n. niger* has declined up to 90% since 1950. Habitat loss has been implicated as the initial cause

of the decline of both subspecies, but population demographics also may be important. We used mark-recapture methods to estimate the annual survival probability of adult Black Terns for two populations in the U.S. (Wisconsin, Maine) and one in the Netherlands. From 1999–2010, 796 adults were trapped and ringed at two colonies in Wisconsin, with subsequent encounters based on recaptures only. Cormack-Jolly-Seber models indicated a constant annual survival probability of  $0.62 \pm 0.05$  (SE); a model accounting for transience increased the estimate only slightly ( $0.66 \pm 0.05$ ). The Maine study (1997–2002) relied both on recaptures and resightings of colour-ringed birds ( $n=206$ ) from seven colony sites. Annual survival was modeled as constant and estimated to be  $0.68 \pm 0.05$ . Estimates from a mark-recapture study of a Dutch population (1999–2008,  $n=146$ ) were similar ( $0.62 \pm 0.08$ ), but a smaller study ( $n=25$ ) with a higher recovery rate based on resightings of colour-ringed birds suggested higher adult survival ( $0.78 \pm 0.06$ ). Taken together, these estimates for both Old- and New-World subspecies are considerably lower than those reported for other tern species, and suggest that high adult mortality may be one factor responsible for the population declines noted in areas of intensive study. Recapture probabilities, however, were very low for all three studies that relied on mark-recapture methods, suggesting a lack of breeding site fidelity among individuals in these populations. The resighting study also provided data on site fidelity and ring loss and we will discuss the implications of different methods.

## Symposium: Rise and Fall of Gull Populations

### Gulls in Two Worlds: the rise and fall of gull populations in the North Atlantic

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For much of the twentieth century, populations of many larid species on both sides of the Atlantic increased dramatically in response to factors including increased food availability in the form of open landfills and fisheries by-catch, decreased human persecution, and the reduction or elimination of mammalian and avian predators. From a position of relative rarity in some portions of their range, gulls increased to a point where they became regarded as “nuisance birds” or “pests” subject to control measures including harassment and lethal removal. In the Northeastern United States Herring Gull *Larus argentatus* and Great Black-backed Gull *L. marinus* populations probably peaked between the mid-1970s and early 1990s and have shown significant declines in subsequent censuses. Similar declines have been reported in the United Kingdom and northern Europe. Possible causes of these declines include decline in food availability through land-fill closure and fisheries collapse and increasing numbers of predators on nesting islands. This symposium will examine the possible causes, consequences, and implications of changes in gull numbers.

### Rise and Fall of Herring and Great Black-backed Gulls in the Northeastern United States: An Overview

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Breeding populations of Herring and Great Black-backed Gulls *Larus argentatus* and *L. marinus* have undergone extensive shifts over the past century and a half. Herring Gulls, apparently common in the mid-19th century, had been largely extirpated as a breeding population in the Northeastern United States by 1900, and the Great Black-backed Gull was not known to nest south of the Canadian Border until 1928. Both species expanded significantly in range and numbers during the first half of the 20th century. Inconsistencies in censusing techniques make precise trend analysis impossible, but an overall pattern is clear. Herring Gulls reached at least 89,500 pairs nesting from Maine to Virginia by 1982, peaking at 110,000 pairs by 1985. Great Black-backed Gulls peaked somewhat later at 35,000 pairs by 1995. Since then both species have exhibited significant declines. Possible causes of these declines include loss of food supplies as open land-fills have closed and fisheries by-catch

has been reduced, increased predation by Bald Eagles *Haliaeetus leucocephalus* and terrestrial mammals, and habitat changes on nesting islands. The primary focus of this presentation will be on selected nesting islands in the state of Maine, USA. Maine has provided much of the nesting habitat for both species of gulls during the past century, and has also been the site of significant management efforts involving gulls and other species. The implications of changes in gull populations on regional ecology will be discussed.

### Recent trends in gull numbers in eastern Canada

**R.C. Cotter<sup>1</sup>, J.-F. Rail<sup>1</sup>, A.W. Boyne<sup>2</sup>,  
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I present results of censuses carried out by Canadian Wildlife Service and collaborators of gull colonies in eastern Canada, from the Great Lakes eastward to the Atlantic Ocean and coast of Labrador, and report population estimates for each species and province. Census data on each species are summarised chiefly from the 1970s (sometimes earlier) to 2000s, and trends given for each species overall and for the major coastlines of each of the six provinces of eastern Canada. Most gull populations grew and expanded in the 1970s and 1980s when food resources were abundant (forage fish stocks, discards and offal from the thriving cod *Gadus morhua* fishery, human refuse) but declined in the 1990s as food became scarcer because of over-fishing of forage fish and cod stocks and closure of municipal dumps in favor of intensively-managed landfills. Some populations judged to be a nuisance (or a hazard) in urban areas were subject to control programs. While recent censuses (since 2000) have shown that some populations continue to decline, many have stabilized or even increased. Most data refer to Ring-billed Gull *Larus delawarensis*, Herring Gull *L. argentatus*, Great Black-backed Gull *L. marinus*, and Black-legged Kittiwake *Rissa tridactyla*; rarer species – Black-headed Gull *Chroicocephalus ridibundus*, Little Gull *Hydrocoloeus minutus*, Laughing Gull *Leucophaeus atricilla*, and Glaucous Gull *Larus hyperboreus* – are also reported.



### Population trends of gulls in Germany: continuous changes at the southern coasts of North and Baltic Seas

**Stefan Garthe**

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Gull populations in northern Germany have undergone remarkable changes over the last six decades. None of the species have remained at a similar population size for a long time, neither at the North Sea nor at the Baltic Sea coast. Numbers of all species breeding at the coasts were low after the Second World War (1939–1945) and increased afterwards. Current trends differ between species and regions and are presented in the talk. The observed trends in gull populations cannot be understood without including effects from anthropogenic activities throughout the period. During and after the Second World War, people were harvesting birds and eggs for food. Later most gull species were being managed under ‘population regulation’ schemes that involved substantial culling. At the same time, gull populations were inadvertently being subsidized by people through increased food availability at refuse tips and garbage dumps on land and fisheries waste at sea. Recent federal and local policies have regulated closing of the landfills. Fisheries are declining and the amount of waste disposal has been subsequently reduced. Land mammals (native and invasive) has also experience this loss of food resource and are playing an increasing roll in predation on gull populations along the Baltic and North Sea coasts.

### The rise and fall of Ring-billed Gulls in eastern North America

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Ring-billed Gulls *Larus delawarensis* were rare at the beginning of the 20<sup>th</sup> century because of intensive exploitation. Under protection from under the Migratory Bird Treaty Act in 1918, their numbers increased throughout North America. In 1990s, the population reached 883,000 pairs with 50 and 32% of the birds breeding on the Great Lakes in Canada and USA, respectively, 14% along the St. Lawrence River, 3% on Lake Champlain, and 1% in Atlantic Canada. Since then, an overall decline of 18% has been recorded. In 2009, we began a study to investigate factors regulating the population, the largest colony located to understand factors that regulate the population. The colony was located on Deslauriers Island, St. Lawrence River and supported 52,000 pairs in 2000 and 44,000 in 2012. It is surrounded by urban landscape, agricultural lands, four landfills located at 8–63 km and few transshipment centers. During incubation, gulls fitted with GPS data loggers primarily selected intensively cultured lands close to the colony but providing intermediate mean energy intake. Throughout the breeding period, landfills and transshipment centres were preferred. Gulls had a lower reproductive output compared to the 1980s, attributed to reduced chick survival, a possible result from the limited access to food at the nearest landfill. Nearly 75% of adults fitted with satellite tracking devices dispersed after breeding with high inter-annual fidelity to their post-breeding sites. Some gulls spent more time in natural habitats (rivers and lakes) while others were more often located in shopping centers. Results suggest that effective deterrence programs at landfills can affect breeding

success and possibly population size. In the long term, reduced input of organic matter at landfills and reduced feeding of gulls by citizens should reduce food resources. We can predict that the observed population decline of Ring-billed Gulls in eastern North American will continue.

## Changing demography of large gulls in Britain

**Ruedi G. Nager**

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Here, I will explore the population trends and underlying factors of gulls in the British Isles. In the UK, very substantial declines have occurred in Herring Gulls *Larus argentatus* over the past 40 years and more recently also in the closely related Lesser Black-backed Gull *L. fuscus*. The population trends are not

consistent between species and areas within the UK which has lead to changes in species' distribution. Such large-scale declines in the population size and distribution of hitherto abundant species are generally indicative of substantial environmental change in their habitat, the coastal waters. A number of causes have been suggested as possible causes of the observed population changes in these species. The observed population declines have been attributed to several possible factors, operating during the breeding or non-breeding season, including changing availability of food (particularly fisheries discards and human refuse), density-dependent effects due to inter- and intra-specific competition, disease, predation, climatic change, degradation of the coastal ecosystem and culling. The substantial regional variation in population change can help to explore these putative causes. Here I will in particular focus on spatial and temporal variation in resource utilization of larger gulls during the breeding and non-breeding season inferred from C- and N-isotope ratios in their feathers. It is expected that changes in populations correlate with changes in trophic level and/or use of foraging habitat.

## Symposium: Seabirds As Bioindicators

### Seabirds as bioindicators in the North Atlantic and Western Mediterranean

**Jaime A. Ramos<sup>1</sup> & Mark Bolton<sup>2</sup>**

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Seabirds are conspicuous, top predators in the marine ecosystem. They are good candidates to act as sentinel organisms (bioindicators). Measureable changes in their distribution, numbers, breeding success, demography or health condition should indicate at-sea alterations such as shortage of prey resources, changes in oceanographic conditions, pollution and overfishing. In addition, seabirds search vast oceanic areas for food, locating the most productive oceanic areas to forage. These foraging hotspots may be used to identify marine areas in need of protection. This symposium will present the results of recent projects evaluating the role of seabirds as sentinels in the North Atlantic and Western Mediterranean. The talks will focus on persistent pollutants, the effects of environmental changes in marine food webs, fisheries by-catch and marine protected areas.

### Top predator seabirds as potential bioindicators for persistent pollutants in marine ecosystems

**Jan O. Bustnes**

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A major threat to seabird species is oil spill. As fish-consuming top predators, seabirds suffer not only from direct contact with contaminants but also from biomagnifications of toxic compounds such as persistent organic pollutants (POPs) and mercury.

POPs have for several decades been recorded at high levels in marine systems, impacting ecosystem health. In seabirds, several biochemical biomarkers have been used to evaluate effects of POPs, and in some cases monitoring of reproductive effects has proven useful as bio-indicators. But a critical question remains: are seabirds good bioindicators of such stressors? Effects of POPs may be observed in seabirds on many levels, from biochemistry and physiology to reproduction and ecological fitness, suggesting that they may be good bioindicators. However, a major challenge is to differentiate between effects from pollutants and other anthropogenic or natural stressors. In addition it may be difficult find biological endpoints that serve in long-term monitoring. In this talk I will discuss advantages and disadvantages of a variety of methods that use seabirds as bioindicators for marine ecosystem health.

### Seabird bycatch in Western Mediterranean fisheries

**Verónica Cortés<sup>1,\*</sup>, Clara Perón<sup>2</sup>, Salvador García-Barcelona<sup>3</sup>, Juan Bécares<sup>4</sup>, Teresa Militão<sup>1</sup>, Beneharo Rodríguez<sup>4</sup>, David Macías<sup>3</sup>, Elena Gómez-Díaz<sup>5</sup>, Jose M. Arcos<sup>4</sup>, David Grémillet<sup>2</sup> & Jacob González-Solis<sup>1</sup>**

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Longline fishery bycatch is considered the main cause of population declines of many albatrosses and petrels worldwide. In the Mediterranean this issue has been little studied but most evidence suggests that seabird bycatch at sea is driving population declines of the three endemic species of shearwaters.

Therefore, there is an urgent need to obtain reliable estimates of seabird bycatch as well as to identify high-risk areas where seabirds and longline fishermen interact. From 2009 to 2013, onboard observers recorded seabird attendance and bycatch rates from artisanal longline vessels operating in the Catalan Sea (northwestern Mediterranean). Within the same period foraging areas of the Scopoli's and Mediterranean Shearwaters *Calonectris diomedea* and *Puffinus yelkouan* were tracked with GPS. In addition, trace element and stable isotope analyses on the first primary feather were used to assign the geographic origin of Scopoli's Shearwaters caught by longline. Overall bycatch rate was 0.198 birds/1000 hooks. The most frequently caught seabirds were Scopoli's Shearwaters followed by Balearic Shearwaters, Yellow-legged Gulls *Larus michahellis* and Audouin's Gulls *Larus audouinii*. The main factors influencing seabird attendance were fishing area and season, but trawling activity also affected the abundance of some species. Overlap analyses of tracks from vessels and seabirds allowed identification of the main areas with a high probability of bycatch. Geographic assignment of Cory's Shearwaters revealed longline vessels operating in the Catalan Sea catch birds from the nearby Balearic Islands but also from other distant colonies. Our study adds evidence to the occurrence of substantial bycatch rates of seabirds in the Western Mediterranean. Moreover, our results revealed for the first time the main areas of interaction as well as the Cory's Shearwater populations affected by this fishery, which should help managing and minimizing seabird bycatch in the Mediterranean.

### **Puffin breeding biology reflects herring availability in the Bay of Fundy marine ecosystem**

**Anthony W. Diamond**

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Breeding biology and diet of four seabird species have been followed since 1995 on Machias Seal Island, at the edge of the Bay of Fundy. Birds breeding there feed on a variety of small pelagic organisms, of which 1-group herring are the most nutritious. Responses of various demographic characteristics of Atlantic Puffin (breeding success, chick growth, adult survival) are related to availability of this resource. Puffin responses and changes in herring biology are related to oceanic and biological changes described in the literature. I emphasise that the needs of seabirds far exceed what might be expected from their energy demand relative to other predators including commercial fisheries.

### **Cory's Shearwaters as sentinels of the effects of environmental variability in North Atlantic marine food webs**

**Jaime A. Ramos<sup>1,\*</sup>, Vitor H. Paiva<sup>1</sup>,  
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This study addresses the role of a seabird top predator, the Cory's Shearwater *Calonectris diomedea borealis*, as a sentinel of environmental changes in the North Atlantic. We equipped birds breeding on Berlenga Island, off Portugal, with GPS loggers during two periods of their life cycle: (1) males and females during the chick rearing period (September) from 2005-2010, to evaluate the influence of climate (as driven by the North Atlantic Oscillation) on (a) marine productivity (i.e. chlorophyll *a* concentration), (b) fish prey abundances and (c) the foraging behaviour of Cory's Shearwater and; and (2) females during the pre-laying period (late April-early May) from 2007-2011, to evaluate the relationship between oceanographic characteristics of the main foraging regions in the North Atlantic and the pre-breeding foraging trips of female Cory's Shearwater. During the chick-rearing period, a dramatic climatic change during the winter of 2009/2010 had a negative impact on marine productivity in the surroundings of the breeding colony, decreased the abundance of pelagic prey fish, and in turn altered the spatial, feeding and trophic ecology of Cory's Shearwater and decreased their reproductive success. During the pre-laying period (April-May), marine productivity proxies in the foraging areas around the colony decreased noticeably from 2007 to 2011 (i.e. an increase in Sea Surface Temperature and a decrease in Primary Productivity) and females responded by travelling farther each year, exploiting in 2011 the productive Grand Bank and Newfoundland Shelf, off Canada, which is about 4000 km from Berlengas. We suggest that long-term monitoring of the foraging behaviour of top-predators such as Cory's Shearwater is a 'sensitive' proxy to understand the medium- to long-term effects of environmental stochasticity in marine ecological systems.

### **How are seabirds responding to changing fisheries and how do we tell?**

**Stephen Votier**

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Fish extraction by commercial fisheries has fundamentally altered fish populations worldwide. As stock structure continues to change, and as management strategies attempt to halt deleterious impacts, a likely consequence is a reduction in the production of huge quantities of offal and discards. Reforms to reduce discards of over-quota fish catches are generally predicted to have positive effects on marine ecosystems and biodiversity, but may have unforeseen secondary negative consequences for the large guild of scavenging birds habituated this resource. Determining how seabirds will respond to changes in discarding is hampered by methodological constraints. Here I will discuss possible ways in which these changes may occur at the individual, population and eco-system level, and throughout the annual cycle. Moreover I will discuss the potential for positive and negative impacts of fisheries reform, such as those proposed by the new EU Common Fisheries Policy.



## Symposium: Chemical Contamination of Waterbirds

### Chemical contamination of waterbirds: Still an issue of concern?

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Waterbirds have a long and documented history of exposure to environmental contaminants. For example, waterfowl mortality related to ingestion of spent lead shot was identified in the late 1800s. Because waterbirds are often terminal consumers in the food chain and because some contaminants demonstrate significant bioaccumulation, waterbirds especially piscivorous birds often have exceptionally high contaminant tissue concentrations. In the mid-1900s elevated concentrations of 'legacy' contaminants (e.g. DDE, PCBs) were associated with population declines in several waterbird species including Brown Pelicans (*Pelecanus occidentalis*), Double-crested Cormorants *Phalacrocorax auritus*, and Black-crowned Night-Herons *Nycticorax nycticorax*. Legislation reducing and eliminating the production of some of these chemicals resulted in dramatic improvements in the status of these populations. Over time, contaminant evaluations on waterbirds have been successfully carried out for the full spectrum of organic (e.g. PCBs, dioxins & furans, DDT) and inorganic (e.g. mercury, lead, cadmium) contaminants. The studies of these legacy contaminants have over the past decade been extended to include contaminants of emerging concern (CECs) such as the polybrominated diphenyl ethers (PBDEs – flame retardants) and perfluorinated compounds (PFCs – stain repellants). For some of the legacy contaminants, current exposure may now be of limited concern or restricted to specific hotspots. For other contaminants, such as the CECs, there may still be a continental or worldwide concern. This symposium touches on selected threats of environmental contaminants to waterbirds including both legacy contaminants and CECs. This subject cannot begin to be evaluated with a handful of studies, however, we hope to initiate the conversation using five examples. These studies emphasize that environmental contaminants are a continuing threat to the health and survival of waterbirds worldwide.

### Ecological impacts of environmental contaminants and feeding conditions in a top predator seabird: observational and experimental evidence

**Jan O. Bustnes**

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Detrimental effects of anthropogenic pollutants may be worse if organisms are exposed to natural stress. In this study we examined whether negative effects of persistent organic pollutants (POPs) may be influenced by feeding conditions in Great

Skuas *Stercorarius skua* by experimental feeding in three different colonies on a temperate-arctic gradient (60–74°N): Shetland (1 year), Iceland (1 year) and Bjørnøya (2 years) in the Norwegian Arctic. The concentrations of organochlorines (OCs) and brominated flame retardants (PBDEs) were measured in plasma of parent birds (totally 222 birds); concentrations being highest at Bjørnøya and lowest at Shetland (up to 10 fold difference). The breeding conditions in the different colonies varied greatly, being favourable on Shetland and on Bjørnøya in the second year, whereas conditions were poor on Iceland and at Bjørnøya in the first year. In Iceland and Shetland there were positive relationships between hatching date and females POP loads, suggesting negative impacts on the onset of reproduction. In addition, chick hatching weight was negatively related to the mother's POP level on Iceland. There were also negative relationships between adult return rate between breeding seasons and POPs, especially PBDEs, both for Bjørnøya in the year following poor breeding conditions, and at Shetland following the season in which reproductive effort was high. During poor chick rearing conditions, as found on Iceland, there were negative relationships between chick growth and POPs. However, in experimentally fed birds the negative relationship with POPs was not found suggesting synergies between feeding conditions and POPs. This study indicates that the negative impact of POPs may differ depending on the healthiness of a population and the feeding conditions under which it breeds.

### Effects of environmental methylmercury exposure on mate choice and steroid hormone expression in White Ibises *Eudocimus albus*

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While methylmercury is known to negatively affect reproduction in birds, most experimental research has focused on decreased hatch success, developmental abnormalities, and parental behavior as endpoints. We raised over 200 White Ibises *Eudocimus albus* from chick stage to sexual maturity on environmentally relevant diets containing 0, 0.05, 0.1 and 0.3 ppm methylmercury in groups of 40 birds each. We found male-male pairing behavior increased with mercury exposure, with up to 55% of males participating in long term male-male and reproductive activities. Male-male pairing was also responsible for a significant decrease in reproductive success in dosed groups. Male-male pairing was not related to sex ratio, constrained mate choice, or group location. After controlling for stage of nesting, mercury exposure was also correlated with altered patterns of fecal testosterone, estrogen and corticosterone. Within dosed groups, hormones of homosexual males differed from heterosexual males in the same direction as groups did with increasing mercury exposure. We suggest that low, chronic mercury exposure altered both mate choice and endocrine expression to a degree that would affect demographic trajectories in the wild.

## Environmental contaminants and waterbirds in the Great Lakes

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The Great Lakes of the United States and Canada have had extensive contaminant monitoring programs that have utilized waterbirds as the sentinel species. Environment Canada has been a pioneer in this regard with not only monitoring for contaminant exposure, but archiving samples that can be analyzed in the future when information on new or different contaminants is needed. Even though polychlorinated biphenyls (PCBs) and other legacy organic contaminants have decreased in Great Lakes' bird tissues (Herring Gull *Larus argentatus* eggs) by >90% over the past 30 years, newer contaminants such as the brominated flame retardants (PBDEs) and perfluorinated contaminants (PFCs) have been discovered and quantified in avian tissues. Some of these newer contaminants are being found at levels of concern. The Great Lakes Restoration Initiative (GLRI), started in 2010 by the US Environmental Protection Agency (EPA) provided funds to assess the status of both legacy and contaminants of emerging concern across all five Great Lakes. Tree Swallows *Tachycineta bicolor*, an aquatic passerine, are being used as the sentinel species because they nest consistently in highly industrial and urban landscapes that are common in the Great Lakes. Whereas many of the legacy contaminants that have been implicated in adverse population level effects in the past are now far below effect levels in the Great Lakes, there are still some isolated areas where legacy contaminants, primarily dioxins and furans, are at levels of concern. Legacy contaminants have been replaced by other contaminants, such as PBDEs and PFCs, so work is still needed to assess these as well as the tens of thousands of new contaminants that are entering the market annually and which find their way to aquatic habitats and waterbirds.

## The Black Stork as a 'new' victim of organochlorine contamination – history of research and current knowledge of a state

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The probability of DDT contamination was first mentioned by Hungarian colleagues during the 4th Black Stork Conservation and Ecology Conference in 2008. On the basis of this warning, we began to devote particular attention to contaminants as a potential cause of the population decline of the Black Stork *Ciconia nigra* in Latvia. In the following years we involved other countries from the species breeding range into this research. Failed eggs were collected from nests in Estonia, Belarus, Poland, Czech Republic, Germany and Belgium. DDT or its breakage products were found in all analyzed eggs. The high ratio of DDT to the sum of DDT and metabolites indicated recent contamination; however attempts to link DDE contamination with the failure rate of affected populations have been

unsuccessful. Also, the reduction in eggshell thickness has not (yet) reached the levels described as critical for other affected species. However, we have found a significant negative relationship between DDE concentrations and egg volume which in turn negatively affects hatching probability – eggs smaller than certain size fail to hatch. Another DDE-related impact is the delay in egg laying. The origin of DDT remains unknown. Most data, including analyses of other bird species eggs collected in Latvia, namely Osprey *Pandion haliaetus*, European Roller *Coracias garrulus*, Hoopoe *Upupa epops*, Marsh Harrier *Circus aeruginosus*, White-tailed Eagle *Haliaeetus albicilla* and Eagle Owl *Bubo bubo* indicate Africa as a potential source. In this presentation I will analyze the information we have collected so far and discuss how DDT contamination may have affected the Black Stork during the previous contamination period.

## Lead poisoning in waterbirds: Do limitations in the perception of risk reduce the compliance of Pb shot ban?

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Lead (Pb) has been an excellent material for hunting ammunition due to its high density and softness. Unfortunately, it is one of the most toxic heavy metals and spreading it in the environment makes hunting an unsustainable practice. The accumulation of spent Pb shot pellets is especially of concern in wetlands where waterbirds have been intensively hunted. High prevalence of Pb shot ingestion in waterbirds has been detected around the world and, in consequence, an increasing number of countries have adopted regulations to reduce the use of Pb shot in wetlands. However, the compliance of the ban of Pb shot differs among countries and it seems to be lower in Europe than in North America. In the Ebro delta (NE Spain), the prevalence of Pb shot ingestion in hunted waterfowl in the 1990s was as high as 30% in Mallard *Anas platyrhynchos* and 69% in Common Pochard *Aythya ferina*. Ten years after the implementation of the ban of Pb shot use over protected wetlands in Spain in 2001, these rates of Pb shot ingestion have declined to 15% and 35%, respectively. Ban compliance by 2008 in protected lagoons of the Ebro delta was high, with  $\leq 2\%$  of hunted birds with only embedded Pb shot. However, this ban was not implemented at feeding sites in rice fields, where the ducks are still shot with Pb during full moon nights. Game meat Pb levels in waterfowl that had ingested Pb shot and/or birds killed with Pb ammunition in the Ebro delta were above maximum residue levels according to EU regulation. Therefore, more strict compliance on the use of Pb shot and an enforcement of the ban compliance can reduce game meat Pb levels by both the decrease in Pb shot ingestion rates and Pb embedded ammunition in birds. Despite the extensive research performed on lead poisoning, further studies on sublethal and population effects in birds and game meat consumers may be needed to increase the perception of Pb-related risk among hunters to favour Pb shot ban compliance.



## Symposium: Waterbirds in The Wadden Sea

### Habitat use and connectivity: important notions for conservation of the Wadden Sea for migrating waterbirds

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The Wadden Sea is of crucial importance for large numbers of waterbirds, either for breeding, overwintering or stopping over. Yearly 10–12 million waterbirds use the Wadden Sea for shorter or longer periods. Of 52 bird species more than 1% of the world population occurs in the Wadden Sea during a period of time over the year. Because of her strategic position on the East-Atlantic Flyway the Wadden Sea is a crucial link in a global meta-ecosystem connected by migrants. Its location in a modern western populated and developed society, however, poses threats to its conservation. In order to protect such a dynamic intertidal area we cannot limit ourselves to the monitoring of annual fluctuations in animal life, but we need to answer more fundamental questions as to what factors may limit the size of bird populations. For instance, we need a better understanding of questions such as how inter- and intraspecific competition patterns may have shaped distribution patterns between species, and between sex- and age-classes within species. This should yield better insights in the relationships between food sources and bird distributions and how these relate to carrying capacities for species.

### Stop using that stop-over! Changing patterns of habitat use by staging Icelandic Black-tailed Godwits *Limosa limosa islandica* in the Netherlands

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Adult Icelandic godwits exhibit high levels of site fidelity to stopover sites at both spatial and temporal scales which may impact their ability to respond to current levels of environmental change. Understanding how migratory species respond to environmental changes, and the consequences of those responses, is important for protecting populations. This is especially critical, for long-lived species which might experience several forms of environmental change throughout their lifetime. Since the 1990s, the ecology and population dynamics of Icelandic Black-tailed Godwits have been studied in detail, and marked individuals have been tracked by a network of volunteer observers throughout their migratory range. Habitat quality for breeding and wintering sites has been quantified. This tracking information provides data for correlating use of

breeding, passage and wintering sites with individual fitness. Icelandic godwits traditionally winter in estuarine habitats, foraging on macrobenthos. Over the last decade, however, an increasing number of individuals have started to use freshwater sites (e.g. rice-fields), foraging primarily on plant material. During pre-nuptial migration a similar change in habitat selection has occurred with godwits increasingly using wet grasslands in England and in the Netherlands. A smaller proportion of the population is currently using traditional staging sites in the Wadden sea while an increasing number of individuals are using novel sites in wet grassland areas. We explore the fitness consequences of occupying different habitats, the level of connectivity between these sites and potential individual level consequences of the current environmental changes influencing the migratory range.

### Sex-specific winter distribution in a sexually dimorphic shorebird is explained by food resources rather than body mass

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Sexual size dimorphism implies correlated differences in energetic requirements and feeding opportunities, such that sexes will face different trade-offs during winter site selection. In seasonal migrants this could result in a differential spatial distribution across the wintering range. To identify the ecological causes of sexual spatial segregation, we studied a sexually dimorphic shorebird, the Bar-tailed Godwit *Limosa lapponica lapponica*, in which females have 25% longer-billed and 20% heavier than males. Due to their lower surface to volume ratio, females should have a lesser disadvantage in colder areas, compared with the smaller males (Bergmann's rule). Colder areas have the benefit of being closer to the breeding grounds. Here, in a comparison between the main five intertidal wintering areas across northwest Europe, we show that females occurred further north and east than males, a pattern consistent with Bergmann's rule. However, at sites where females predominated, the worms they foraged on lived deeper, were largely out of reach of the smaller-billed males, and were larger and more abundant than at sites where males occurred more. The fact that females predominantly use the bottom layer and the males use the top layer for foraging indicates resource partitioning. Indeed, females were more abundant in places where bottom layer benthic densities were higher. However, males did not occur more at sites with more benthic food in the top layer. This may be explained by our finding that the benthic food in the two layers were correlated and that females are the dominating sex in dyadic interactions. This might leave males with the second best choice of a wintering area. In any case, resource partitioning best explained the differential spatial distribution of males and female godwits across northwestern Europe.

## Density dependence in Spoonbill survival: when and where does it happen?

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In the 1960s, the Eurasian spoonbill population *Platalea leucorodia* faced a severe decline, which was mainly attributed to organochlorine pesticides pollution and to the disturbance and destruction of suitable foraging and breeding areas. In the Netherlands, the population low of 148 breeding pairs was reached in 1968. Since then, the Dutch spoonbill population has been recovering up and reached 2534 breeding pairs in 2012. This recovery coincided with a shift in the spatial distribution of breeding colonies. In 1968 most spoonbills (81%) bred on the mainland, in reed beds and swamp habitats. In 2012 58% bred on the Wadden Sea islands. The birds' range expanded from the Netherlands to Germany and Denmark. Here we investigate the demographic parameters underlying the observed population growth and range expansion. Using mark-recapture data from spoonbills individually colour-banded in the Netherlands as chicks, we estimated changes in seasonal survival and emigration rates (i.e. the probability to breed outside the Netherlands) between 1988 and 2010, during which the population increased almost four-fold. We found evidence for density-dependent survival and emigration rates, with the seasonal timing of density dependence varying with age. Survival of 1st year birds decreased over the years in all seasons (including the post-fledging phase in the Netherlands), whereas adult survival decreased most notably during late winter and spring migration. We discuss the potential role of changes in the Wadden Sea and with respect to spoonbill survival and distribution, and predict future trends for the spoonbill population in the Wadden Sea area.

## The importance of the Wadden Sea for Sanderlings *Calidris alba*

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Sanderlings typically occur along sandy and rocky shorelines. During migration periods in both spring and autumn they move to the mudflats of the Wadden Sea. Based on daily high tide roost counts and histories of individually colour-ringed sanderlings near the island of Griend in the central Dutch Wadden Sea, we estimate autumn stopover duration of moulting and non-moulting sanderlings and estimate the total passage population size, taking turnover into account. Sanderlings that winter south

of the Sahara spend a much shorter period (25.5 days) in the Wadden Sea than those wintering north of the Sahara along western European shorelines (115 days). The European wintering Sanderlings move from the Wadden Sea to the sandy beaches after having completed their wing moult, which underlines the importance of the Wadden Sea as a moulting area. By use of frequent counts, measurements of food availability and human activity during winter and spring at a Wadden Sea island and along the Dutch mainland coast, we begin to address the question of why Sanderlings do not spend the winter on the mudflats of the Wadden Sea.

## Sexually distinct foraging strategies and individual specialization in an omnivorous seabird

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Sex, age, morphology and individual specialization may all contribute to intra-specific differences in foraging behavior, and these differences may influence an individual's fitness, especially during the breeding season. Lesser Black-backed Gulls *Larus fuscus* are opportunistic seabirds, with a broad omnivorous diet. At the Kelderhuispolder breeding colony in the Wadden Sea, individuals have numerous marine, intertidal and terrestrial foraging opportunities. We examined the influence of breeding status, gender, and morphology on the foraging behavior of Lesser Black-backed gulls by combining GPS tracking data from 34 individuals and 2,199 foraging trips, with dietary information and reproductive status. We found sexually distinct foraging strategies that were maintained throughout incubation and chick-care. Larger males travelled farther from the colony than females, spent more time in the North Sea, feeding mostly on fishery discards at offshore trawlers and remained longer at the nest during nest visits. In general, females foraged predominantly on land or in the Wadden Sea. Females spent significantly more time in the Wadden Sea on weekdays compared to weekends, and were tracked almost exclusively within deep gullies, suggesting that these individuals were foraging in association with fisheries. Foraging range, trip duration and the proportion of time at sea increased with wing length and individuals differed in foraging behavior along a continuum of predominantly terrestrial to predominantly marine foragers, suggesting individual specialization during the breeding season. Our findings did not support the usual inference that sexual segregation is mediated primarily by differences in competitive strength (i.e. size differences) as both sexes foraged in competitive environments around fishing vessels. A combination of individual specialization and sexually distinct foraging strategies during breeding, as shown in this study, may increase an individual's lifetime reproductive success by reducing resource competition between sexes (and within pairs) and/or through risk partitioning.



## Symposium: Migratory Connectivity in Arctic Geese

### Challenges to migratory connectivity in arctic geese

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Arctic goose species connect temperate wetlands and arctic tundra habitats through a global network of flyways. Influence of global change on life histories of species in temperate and arctic regions is inevitably becoming more severe. Changes in human land use and in climate modify plant phenologies and thereby forage use of primary consumers, such as herbivorous geese. In addition, predator communities are altered and disturbance regimes shift which affects birds in the breeding season but also at staging sites when foraging in large social flocks. The symposium will comprise studies from different flyways and hopes to spark a vivid scientific discussion on flexibilities and limitations of habitat connectivity in arctic migrants.

### Climate change and contrasting plasticity in timing of a two-step migration episode of an arctic-nesting avian herbivore

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Greenland White-fronted Geese *Anser albifrons flavirostris* wintering in Britain and Ireland migrate over the sea for 700–1,200 km to stage 3–5 weeks in Iceland in spring, continuing a similar distance over the sea and Greenland Ice Cap to West Greenland breeding grounds. Geese departed Ireland on average 15 days earlier in 2012 than in 1969 because they attained threshold fat stores earlier. Over that period, Iceland spring-staging geese shifted from consuming underground plant storage organs to grazing managed hayfields, which provide fresh grass growth despite sub-zero temperatures, when traditional natural foods are inaccessible in frozen substrates. Geese arrived in Iceland in much fatter condition in the springs of 2012 and 2013 compared with 1997–1999 and 2007. Fat accumulation rates were significantly lower in 2012 and 2013 (when geese arrived three weeks early) than the earlier springs. Although geese accumulated sufficient fat stores earlier in Iceland in 2007, 2012 and 2013, they departed around the same date in all studied years, prolonging spring staging by three weeks. Plasticity in winter departure dates is likely due to improved winter feeding conditions (enabling earlier departure

in better condition) and a novel predictable food resource in Iceland. Greenland White-fronted Geese attained threshold fat stores in Iceland earlier, but remained rather than depart earlier to Greenland. Despite more rapid summer warming in West Greenland than in Iceland, arrival dates on the breeding areas have not changed since the 1880s, presumably because of relatively cool springs and heavy snowfall there during recent years.

### Carrying capacity of Arctic tundra for geese

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How many geese can be accommodated in the Arctic tundra? How does goose grazing affect vegetation composition and productivity? What are the chances of overgrazing? The dramatic increase in goose numbers in the Arctic tundra has led to an increased grazing pressure. Their grubbing activity has been described as habitat destruction, but also the grazing alters vegetation composition and productivity. The concept of grazing lawns maintained by herbivores has become an unstable state and carrying capacity decreases over time. Only in a long-term study, we can fully appreciate the trophic interactions of plants, herbivores and predators. In the high arctic terrestrial ecosystem on Spitsbergen, the effect of grazing by barnacle geese has been studied for over 25 years. Here we report on changes which ultimately might limit densities of arctic breeding geese.

### Migratory connectivity and the role of parasites

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Migratory animals annually experience at least two different parasitic faunas and are expected to enhance spread of diseases between habitats and facilitate cross-species transmission. But recent research shows that migration also allows the host to decrease the disease levels in the population by leaving behind both infected habitats and sick individuals. The objectives of this study were to determine the risk of infection by parasites and pathogens in relation to habitat and migration strategy, to elucidate the interaction between infection and body mass, and to identify the transmission route of the zoonotic parasite *Toxoplasma gondii* to the high Arctic. We examined immune system activity and parasitic infestation of individuals from sedentary and Arctic migratory populations of wild geese, as well as 32 hand-raised barnacle goslings from both temperate and Arctic regions. Specific and non-specific immune system parameters were quantified from a single blood sample. Sedentary goslings in the Netherlands weighed significantly less, displayed more pathological changes, greater parasitic infestations, and higher non-specific immune activity compared to their Arctic conspecifics. Adult geese were seropositive against *T. gondii* at

all locations, while young geese were seropositive to *T. gondii* only during spring migration. We suggest that *T. gondii* enters the Arctic ecosystem with migratory birds, which are infected on wintering grounds. Furthermore, we suggest that migration reduces pathogen pressure in Barnacle geese, as goslings raised in the Arctic showed minor effects of pathogens and faster growth compared to the sedentary population.

**Population modeling for management scenarios for European Greater White-fronted Geese *Anser a. albifrons*: combining behavioural and demographic effects**

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The Baltic/North Sea Flyway population of Greater White-fronted Goose *Anser a. albifrons* (GWFG) has increased strongly over recent decades. With ca. 800,000 birds wintering, GWFG account for a significant part of annual crop damage costs in The Netherlands. Current policy aims to concentrate geese in designated feeding areas to minimize crop damage elsewhere. Shooting is allowed to support scaring outside the feeding areas and amounts to ca. 40,000 birds per year. As GWFG breeding productivity has declined and population growth slowed down in recent years, the question arises which levels of shooting can be sustained while maintaining the population in a healthy state as required by EU law and international conventions. In answering this question pressures operating elsewhere along the migration route as well as possible exchange of individuals between flyway populations also need to be considered. We aim to do this by parameterizing a metapopulation model using data on breeding productivity, survival and movements based on recoveries of metal-ringed and neck-banded birds. We will also parameterize a dynamic (individual-based) migration model in order to explore expected demographic effects of changes in site use and in conditions (management) in sites along the flyways.

**Flexible migration and range expansion of barnacle geese in times of global change – the green wave revisited**

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Influence of global change on life histories of species in temperate and Arctic regions is inevitably becoming more severe and challenges the connectivity of flyways as well as alternative migration strategies. A changing phenology of plants directly affects primary consumers. Migratory Barnacle Geese *Branta leucopsis* follow consecutive waves of spring plant growth from temperate wintering to arctic breeding sites. Temperature rise and human land use affect forage quality along the flyway. Within 30 years, the goose population has dramatically increased in numbers and extended its breeding range. The expansion has occurred both within the Arctic as well as by colonization of temperate areas. We studied the availability of forage as well as the timing of major life history events (reproduction, moult, survival) in three recently established populations: one Arctic and two temperate (Baltic, North Sea). In the arctic population, timing of hatching was synchronized with the peak in food availability and there was strong stabilizing selection. Although birds in the temperate populations bred 6 weeks earlier than Arctic birds, timing of hatching was late in relation to the food peak, and there was moderate to strong directional selection for early breeding. In the Baltic, absolute timing of egg laying advanced considerably over the 20-year study period, but little relative to spring phenology. In times of advancing springs, the expanding population experiences a growing mismatch between the acquisition of body stores for breeding and rapidly declining forage suitability.



## Orals and Posters

(in alphabetical order of first author's surname)

### The Great Egret Roost Blitz 2012: Mapping and Monitoring Autumnal Waterbird Roosts in the New York City Suburbs

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In temperate North America, Great Egrets *Ardea alba* often occupy communal nocturnal roosts away from the breeding colony after nesting is complete. These roosts, which can vary from a few birds to several hundred, are often found near foraging areas and can persist seasonally in a given location for decades. While the dynamics of breeding colonies are well-studied, relatively little is known about non-breeding roosts, particularly in urban environments. We used a citizen science based approach to locate and monitor non-breeding roosts in northeastern New Jersey and New York City (USA), near the main foraging areas used by waders nesting in New York Harbor. From 14–23 September, volunteers were asked to visit foraging sites at dusk and note the departure direction of Great Egrets (our focal species) and associated species. Subsequent visits were made as needed to triangulate a roost's location. We also located roosts by reaching out to professionals and birders in online forums, and by conducting two evening surveys by boat and plane. When a roost location was confirmed, a volunteer was encouraged to visit it once per week to count Great Egrets as they exited or entered roosts. In 2012, 36 volunteers and staff found eight roosts varying in size (max count) from 5 to 90 Great Egrets. At three roosts that were regularly monitored, peak occupancy occurred in early-October. Peak entry and exit rates to/from roosts occurred about 10 minutes after sunset and 10 minutes before sunrise, respectively. All eight roosts were in trees adjacent to water, with six near fresh water. Most were shared by varying numbers of at least one other species, including Double-crested Cormorant and Snowy Egret. We observed sensitivity to disturbance, including one roost that moved ~0.5 km, apparently due to disturbance by duck hunters. Future work will include expanded fall roost monitoring, and investigations into roost occupancy during spring and summer.

### Possible effects of the use of nasal saddles on diurnal Mallard seasonal behaviour on refuge areas of Western Iberia

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Several studies on population dynamics and migration of ducks have relied on the use of nasal saddles for their marking but little is known about their effects on behaviour of wild ducks. The objective of this paper was to study the effect of nasal saddles on the behaviour of Mallards *Anas platyrhynchos*. Video was used to register eight behavioral categories of Mallards in the Natural Reserve of Dunas de S. Jacinto, Portugal (aggressive interaction, foraging, preening, movement, displaying, vigilance, resting/sleeping and bill scratching), that were compared between saddled and unsaddled wild ducks using zero inflated models. We evaluated the effects of gender, age, time since nasal saddling (3 and 6 months), season (autumn, winter, spring and summer), and the interactions saddle\*sex, saddle\*season, saddle\*age and time with saddle\*season. Our results suggest that nasal saddles may affect the aggressiveness, movement, alert and bill scratching of Mallards, particularly in the short term (< 3 months with the saddle). Saddled males spent significant more time in aggression, foraging, preening, alert and bill scratching activities (1.73%, 7.9%, 4.95%, 4.17% and 4.69% respectively), and less time displaying and resting (1.29% and 11.7% respectively), than unsaddled males. However, saddled females spent significantly more time in preening, displaying, alert and bill scratching activities (5.02%, 3.19%, 5.68% and 1.39% respectively) and less time foraging and resting (4.73% and 12.9% respectively), than unsaddled females. We conclude that nasal saddles although being a good visual marking method for survival, movement and migration studies, may induce short-term changes on the behaviour of Mallards.

### Using triglycerides to evaluate migratory strategies in passerines

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We combined blood Triglycerides and Glucose levels to evaluate differences in migration ecology of two warbler species, Sedge Warbler *Acrocephalus schoenobaenus* and Reed Warbler *Acrocephalus scirpaceus*, at two stopover sites in Central Portugal. We evaluated also differences between these migratory species and a resident species Cetti's Warbler *Cettia cetti*. Sedge Warblers presented significantly higher Triglycerides values reflecting the higher fat mobilization attributed to the smaller number of stopovers during their migratory journey. Instead, Reed Warblers presented lower Triglycerides values and higher Glucose values attributed to longer stopover periods and presumably because they do not make stopovers with extensive fattening at Central Portuguese reedbeds. Migratory birds caught in active migration with acoustic playbacks presented higher Triglycerides due to mobilization of their fat reserves when compared with birds that stopped naturally. The lower Triglyceride values presented in Cetti's Warblers, show that resident species do not need to mobilize fat reserves, and

do not fatten extensively. Triglyceride levels have been used to determine fattening phases in migratory passerines and we further demonstrated that such metabolite can be also used to indicate fat mobilization when passerines are engaged in active migration. Glucose levels showed an opposite trend to that of Triglycerides indicating that birds were feeding recently.

### Population Status and Distribution of three Swan Species *Cygnus* spp. in Turkey

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This study was performed to determine the population status and distribution of three swan species *Cygnus olor*, *Cygnus cygnus*, *Cygnus columbianus* in Turkey. Field surveys were carried out between 2009–2011 in important wetland areas for swans in Turkey. Survey reports between 1945 and 2011, observation data and publications about birds of Turkey were analysed within the study. The results showed that Mute Swans had been observed in 67 areas to date, Whooper Swans in 46 areas and Bewick's Swans in 26 areas. Turkish Thrace has the biggest overwintering population of three species and also the biggest breeding population of Mute Swans. The results also indicate that swan species have overwintered regularly with huge numbers of individuals in Turkish Thrace, Lakes Region and the Turkish coast of the Black Sea and they have irregularly visited as small flocks in some other parts of Turkey. The total overwintering population has fluctuated by years. However, 2010's wintering population consisted of approximately 13,000 individuals of three species as to study results. Only the Mute Swan is resident among them. However, there are only 10 known pairs breeding in Turkey. The others are winter visitors.

### Distribution and numbers of *Chlidonias* terns in reaction to changes in floating water vegetations at water bodies in the Middle Dnieper, Ukraine

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In the 1950s levees were created along the Middle Dnieper river resulting in several water bodies, caused by the formation of an inner delta. Avian and water plant communities are still reacting to these new conditions. For instance, *Chlidonias hybrida* is a colonizing species, having expanded to the northern part of Dnieper from southern deltas in the 1980s. The areas occupied by the communities dominated by floating-leaved plants *Nuphar lutea*, *Nymphaea alba* and *Trapa natans* – nesting habitat for *Chlidonias* terns – increased significantly. Then *Nymphaeidae* vegetation was replaced by *Trapa natans* plant community between 2007 and 2012. The number of Whiskered Tern colonies has increased from 1 to 10 and the numbers of

nesting pairs from 20 to 820 in the same period. This increase was in conjunction with the shift in water plant communities. The habitats formerly dominated by nymphaeids are now mainly dense beds of *Trapa natans*. Breeding success is significantly lower (0,9) in the nesting habitats dominated by *Trapa natans* compared with nymphaeidae communities (1,6). Changes in the floating-leaved plant communities lead to annual shifts in colonies location on reservoirs. Conversely, *Chlidonias niger* is a native species for the Middle Dnieper basin. The total number of nesting pairs has decreased considerably from 500 in 1980s to 100–120 in 2000s. Recently a slow increase of Black Tern numbers has been observed in 2007–2012 mostly due to the increasing number of colonies, from 3 to 11. The main nesting habitats of Black Tern on the reservoirs are communities dominated by *Typha* sp., *Sparganium erectum* and *Nuphar lutea*. The nesting substrate is formed by floating rhizomes and dead vegetation of these plants. At Dnieper reservoirs, the areas occupied by aquatic floating vegetations have increased significantly in last 30 years and recently caused a slow population recovery of Black Tern.

### Flight Behavior of Breeding Piping Plovers *Charadrius melodus*: Implications for Risk of Collision with Turbines and Other Human Structures

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As the focus on clean energy continues in the United States, collisions of flying Piping Plovers *Charadrius melodus* with turbines in coastal areas poses a potential threat that could counteract recent recovery successes gained through protection and management. We studied flight characteristics and flight behavior by breeding Piping Plovers at five study sites along the Atlantic coast. Using color-banding and radio telemetry to conduct observations, a total of 189 non-courtship flights was mapped in 2012 at New Jersey study sites, and a total of 516 non-courtship flights was mapped at Massachusetts study sites. Preliminary results suggest that the center points of flight paths were clustered by pair (MRPP, AV: Test Statistic = -39.59, ST: Test Statistic = -13.60, SH: Test Statistic = -35.87, CH: Test Statistic = -43.78, DN: Test Statistic = -50.20;  $P < 0.001$  for all sites). We found differences in day-time flight frequency between three Massachusetts study sites and Stone Harbor, New Jersey (Negative Binomial Regression,  $F_{4,127} = 2.69$ ,  $P = 0.034$ ). Average visually-estimated flight height of Piping Plovers from 1,066 observed flights was 2.63 m and 49.9 percent were less than 1.5 m high. A total of seven flights was video-recorded and the average flight speed was 9.02 m/s. Daytime flight frequency of breeding Piping Plovers may be dependent upon habitat configuration, and flight paths of breeding Piping Plovers typically remain within the boundaries of their nesting and feeding territories. The data collected on flight frequency, flight height, and flight speed of breeding piping plovers can input directly into existing collision-risk models, and our results can be used by resource agencies to evaluate permit requests for turbine construction in Piping Plover breeding areas.

## The use of telomeres as a biomarker of ageing in a long-lived seabird

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Seabirds are long-lived and populations are characterized by high inter-individual differences in reproductive success and survival. These attributes make them a promising model to study ageing and the costs of reproduction. Telomeres, DNA-protein complexes at the ends of eukaryotic chromosomes have been proposed as biomarker of ageing. They function in genome stability and telomere length has been associated with cellular senescence, ageing and lifestyle. Short telomeres indicate poor health in humans and reduced survival probability in several bird species. Within a cell telomere length varies between chromosomes. Thus, different measuring ranges within the telomere length distribution for an individual are possible and may not perform equally well as biomarker of ageing. We measured telomere length in erythrocytes of free-living Common Terns *Sterna hirundo* of known sex and age using terminal restriction fragment analysis. This yields a distribution of telomere lengths for each sample or individual. We evaluated how different subsets (percentiles) of the telomere distribution relate to age, survival and fitness components using cross-sectional as well as longitudinal data. Individuals with long telomeres have the highest survival and this was best predicted within-individually by the longer telomeres. Longer telomeres within a genome lost more base pairs with age than shorter telomeres. Likewise, fitness proxies such as arrival date at the breeding ground, laying date and reproductive success, were best predicted by telomere length at the higher percentiles. We suggest that as longer telomeres lose more base pairs per unit time, they better reflect the various forms of stress that accelerate telomere shortening and therefore function as the better biomarker.

## Sex ratio adjustments in common terns: influence of mate condition and maternal experience

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Adaptive sex allocation has frequently been studied in sexually size dimorphic species, but far less is known about patterns of sex allocation in species without pronounced sexual size dimorphism. Parental optimal investment can be predicted under circumstances in which sons and daughters differ in costs and/or fitness returns. In Common Terns *Sterna hirundo*, previous studies suggest that sons are the more costly sex to produce and rear. We investigated whether hatching and fledging sex ratio and sex-specific chick mortality correlated with the ecological environment (laying date, clutch size, hatching order, year

quality) and parental traits (condition, arrival date, experience, breeding success), over seven consecutive years. Population-wide sex ratios and sex-specific mortality did not differ from parity, but clutch size, mass of the father, maternal breeding experience and to some extent year quality correlated with hatching sex ratio. The proportion of sons tended to increase in productive years and when the father was heavier, suggesting the possibility that females invest more in sons when environmental conditions and the partner's state are good. The proportion of daughters increased with clutch size and maternal breeding experience, suggesting a decline in breeding performance or a resource balance solved by producing more of the cheaper sex. No clear patterns of sex-specific mortality were found, neither global nor related to parental traits. Our results suggest lines of inquiry for future studies on adaptive sex allocation in sexually nearly monomorphic species, where adjustment of sex ratio related to parental factors and differential allocation between the offspring may also occur.

## Causes and consequences of between-individual variation in within-individual rates of improvement and senescence in a long-lived seabird

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Longitudinal studies of various vertebrate populations have recently demonstrated within-individual early-life improvement and late-life decline in reproductive performance and/or survival probability to be ubiquitous. Relatively little is known, however, about the extent to which there is between-individual variation in rates of improvement and decline, or, if so, about causes or consequences of such variation. We hypothesise conditions during early development to have long-term effects on fitness, and analyse the reproductive lives of Common Terns *Sterna hirundo* to quantify effects of such conditions on rates of improvement and decline, as well as reproductive lifespan and lifetime reproductive success. Our candidate early development conditions include (i) cohort effects of breeding density and success, (ii) parental age and breeding experience effects, and (iii) natal brood characteristics such as laying date and success at various reproductive stages. Our results show that beneficial early-life conditions do not only predict recruitment success of individuals, but also confer consistent lifelong benefits for reproductive performance and survival.

## Do seabirds avoid offshore wind farms during construction? The case of the Common Guillemot *Uria aalge*

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Given the rapidly increasing number of offshore wind farms in the German sector of the North Sea, the potential of disturbance of seabirds during the construction phase has to be considered in environmental impact assessment studies. Due to differential sensitivity to disturbances, the effects need to be assessed on a species-specific level. Here, we report on the results of

monitoring seabird abundance during the installation (since 2010) of an offshore wind farm (80 turbines, 5MW each) with special emphasis on the Common Guillemot *Uria aalge*. This species has been identified as the most abundant seabird in pre-construction years and occurred throughout the season reaching highest numbers during post-fledging dispersal in late summer. Preliminary results show that the spatial distribution of guillemots pre-construction was similar at the wind farm site and the reference area, whereas highest densities were observed in the reference area during construction. More specifically, only very few individuals were counted by both ship and flight transect surveys inside the wind farm area and its immediate vicinity, which could be due to high ship traffic accompanied with construction activity. Results will be complemented with data from still ongoing investigations in order to confirm our findings. Studies from operating offshore wind farms in Denmark and the Netherlands show equivocal results suggesting that avoidance effects both during construction and operation are not only species-specific but also site-dependent.

### Tracking Lesser Black-backed Gulls through the year reveals annual, seasonal, and individual variation in seabird-wind farm interactions

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The marine environment is increasingly pressured from human activities, including offshore renewable energy developments. However, in seeking to understand the potential for impacts of such developments on specific breeding populations, studies have seldom considered either the consequences of: (1) seasonal, (2) annual and (3) individual variation in habitat use, or the connectivity between breeding populations and offshore developments outwith the breeding season. During 2010 and 2011, we deployed a total of 25 long-life GPS loggers to breeding Lesser Black-backed Gulls at the Alde-Ore Estuary Special Protection Area (SPA) in southeast England, located nearby to existing, consented and proposed offshore wind farms, to understand patterns of movement through three breeding seasons (2010, 2011, and 2012) and subsequent migration and wintering periods. The extent of movements and areas used, and hence interaction with offshore wind farm areas varied significantly within breeding seasons, peaking between late June and early July. Birds used offshore wind farm areas more in 2010 than other years, a pattern that could not be explained solely by annual differences in productivity. Individual birds tracked across multiple years differed in their seasonal patterns of wind farm usage, with some birds foraging in wind farm areas in some years but not in others. While some birds wintered in southern England, most moved to Iberia or north Africa. Migration routes out of England were concentrated in a band across the English Channel, becoming more dispersed across the Bay of Biscay. The data collected by this study has enabled the potential exposure of this specific protected population to the risks associated with offshore developments to be quantified not just within the breeding season, but across the year.

### The effect of body condition on short- and long-term fitness: why fat plovers may be better plovers

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Individual condition of precocial chicks prior to fledging can have significant impacts on chick survival and thus population growth. Less is known, however, about the potential sub-lethal and chronic effects of poor body condition on lifetime fitness. We studied the relationship of chick fledging condition with short- and long-term survival and with measures of reproductive output in Piping Plovers nesting on the Missouri River from 2005–2012. In addition, we examined ecological and management variables to determine which of these were determining the growth and condition of chicks at fledging. We found that the condition of fledglings was not only associated with hatch-year survival, but also was positively correlated with survival in subsequent years, such that birds in better condition at fledging had higher lifetime survival than those in worse condition. Moreover, chicks that fledged in better condition than others, tended to be in better condition as adults. Chick growth and condition at fledging were related to measures of parental condition, availability of foraging habitat, and to environmental variables. In particular, the density of individuals per unit of foraging substrate was negatively correlated with the rate of chick growth as well as the condition of chicks at fledging. On the Missouri River, water management policies tend to increase densities during chick rearing, potentially affecting the long-term fitness of the plovers. Our results indicate that there are significant carryover effects of chick condition that could be capitalized on by managers to improve overall population fitness.

### Spatial foraging variation and width of trophic niche: testing the 'niche variation hypothesis' in a pelagic seabird species

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The Van Valen (1965) 'niche variation hypothesis' postulates that populations with wider niches are more variable than populations with narrower niches. We determine whether variations in foraging spatial distribution at sea and trophic niche width of a pelagic seabird species are associated in order to test this hypothesis. The extent of such a relationship was assessed using a wide-ranging mobile apex predator, the Cory's Shearwater *Calonectris diomedea*, as a model marine species, along a three

year study (2010–2012), during both the pre-laying and chick-rearing periods. We used individual movement data and stable isotope data, analysed using recent metrics based in a Bayesian framework, of 69 adults breeding on a small neritic island in the North Atlantic (Berlenga Island, Portugal). Our results confirm that trophic niche expansion arises via increased variation in spatial distribution at sea among individuals of this population, and potentially of pelagic seabirds in general, providing support for 'niche variation hypothesis' in the context of foraging ecology.

### The role of individual foraging specialization in the trophic relationships between seabirds and the marine environment

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Most ecological studies treat conspecific individuals as ecologically equivalent, but intra-specific variation in individual foraging strategies can be large. The extent of such intra-specific relationships among seabirds within the same population was assessed in three different seabird species with different characteristics (Wandering albatross, Cory's shearwater and Yellow-legged gull), and investigated as to whether they were associated with the environment and resources exploited. The fieldwork was conducted in Bird Island (South Georgia), Corvo Island (Azores archipelago) and Berlenga Island (Portugal), covering four different populations exploiting specific marine environments during the breeding season, from 2009 to 2012. Together with conventional dietary methods we used a combination of intrinsic and extrinsic markers, such as stable isotope and individual movement data, to document the existence of individual specialization and examine its relative incidence and ecological implications. Patterns of individual consistency were found in all studied species, highlighting individual feeding preferences in the ecological role of these species and potentially of related species. Such consistency, however, varied among species and populations and fluctuations on individual consistency were related to temporal changes in the availability and predictability of resources. This study corroborates that individual variability within a seabird population may be regulated by intra-specific competition, geographic location and environmental characteristics. Overall, our results suggest that studies assuming a colony or sub-colonies as ecologically homogeneous in terms of foraging ecology can be biased. This study supports the hypothesis that individual specialization may have important ecological implications, such as the reduction of intra-specific competition and, consequently, a high impact on ecological processes and foraging dynamics.

### Winter habitat for Whooping Cranes on the Texas coast: current availability and future trends under sea-level rise scenarios

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The last wild population of the endangered Whooping Crane migrates between breeding grounds in Northwest Territories, Canada, and wintering grounds along central Texas Gulf Coast, USA. Whereas the breeding area supports an expanding population, the wintering area may be a limiting factor to achieve the downlisting recovery goal of 1,000 individuals and 250 nesting pairs. A collaborative approach to achieve conservation acquisition/easement goals of at least 125,000 acres of winter habitat is necessary by using GIS to identify essential habitat area adjacent to the core recovery area. Overall objectives involved developing maps that target current needs and evaluating landscape changes under various sea-level rise scenarios. Present habitat use was determined from recent Whooping Crane surveys joined to land cover classes. Potential expansion and winter territorial areas were delineated based on quantified habitat use patterns. In the project study area, overall habitat extent that appears suitable for potential crane winter use could meet the 125,000-acre goal. However, ground verification shows some areas are misclassified and may not be suitable. Crosswalks were constructed using historic habitat conversions in relation to elevation changes to estimate habitat availability under sea-level rise scenarios. Shallow seagrass habitats increased at the expense of coastal marsh, and intertidal flats were converted to coastal marsh. Estuarine marsh inland expansion was limited by existing roads and levees in many areas, and present connectivity opportunities as lower coastal roads and levees become unusable. These results will direct conservation strategies to facilitate endangered Whooping Crane recovery under current and future recovery predictions.

### How do individual Common Shelducks use the German Wadden Sea during the year?

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Almost all adult Common Shelducks *Tadorna tadorna* of Northwestern Europe, that is nearly half of the world's population, gather in a small area of the German Wadden Sea once a year to simultaneously moult their flight and tail feathers. Even though Germany has a high responsibility for the protection of the species, little is known about how individual shelducks use the Wadden Sea, including the moulting sites, in space and time. In 2011 we started to equip a total of eleven shelducks with solar GPS-satellite transmitters which enabled us to trace their movements. Here we show which areas were used by the tracked shelducks during the distinct periods of the year, i.e. during (i) breeding, (ii) pre-moulting, (iii) moulting, (iv) post-moulting and (v) wintering. For these distinct periods of the year we calculated the homerange and the movement rates and discuss



them also with respect to environmental factors like daytime and tidal phases. Furthermore, we analysed how the birds moved between the distinct areas (i to v) in space and time: Some birds visited their later moulting site for a couple of hours and returned to their breeding or pre-moulting site afterwards again using nonstop flights both ways. During the final movement from the breeding/pre-moulting site to the moulting site all birds used more than one stop-over site. Most stop-over sites were used for only a couple of hours but 60 % of the birds used also areas where they stayed for longer than 10 days. All birds stayed much longer in the moulting area than was needed to change the feathers. After finishing moult the birds either stayed near the moulting grounds or returned to their breeding areas stepwise or nonstop to spend the winter there.

### **SHARP: Salt Marsh Habitat and Avian Research Program**

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The Saltmarsh Habitat & Avian Research Program (SHARP) is a large, collaborative initiative to study the ecology and conservation of the tidal-marsh bird community of the US Atlantic seaboard. This community contains several endemics and is threatened by land development, habitat degradation and global sea level rise. The project objectives include identifying key sites for tidal marsh birds between Maine and Virginia and assessing which regions and species are most sensitive to land and seascape change. We use repeated passive and callback surveys to estimate occupancy and abundance of all obligate marsh species using a generalized random tessellation stratified scheme with ~1700 points in ten states. About 450 of these points also have retrospective data that we have collated from 14 organizations, to examine temporal trends. At 20 sites in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey we also perform intensive monitoring to estimate seasonal fecundity of six focal species and adult survival of three marsh-breeding sparrows. The SHARP collaboration also includes 11 graduate students from 5 Universities studying different aspects of marsh bird ecology, including questions of demographics, habitat, predation, and human impacts.

### **Waterbird Road Mortality at Gulf Islands National Seashore, Florida**

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Gulf Islands National Seashore in Florida is faced with wildlife mortality due to vehicle collisions on a paved road running down the center of a barrier island. The road provides access to

recreation areas and historical sites within the Park, and serves as a commuting corridor for people living outside the Park boundaries. Opportunistic surveys by National Park Service staff have documented varying numbers of wildlife carcasses depending on the year, with the majority usually being chicks and adults of Least Terns *Sternula antillarum* but also including young and adults of beach-nesting plovers, and migratory shorebirds. Our objective was to statistically estimate the abundance of wildlife carcasses on the road. We designed a study to unify estimation of carcass loss rates and detection rates using a robust multistate capture-mark-recapture population estimator. We defined two states for carcasses, intact and crushed, because we hypothesized crushed carcasses would be more difficult to detect and might persist longer than intact ones. We supplemented our sample size for scavenging rate estimation by placing 1-day and 10-day old frozen quail carcasses to simulate chicks and adults of beach-nesting birds at randomly placed points along the road, assigning them at random to intact and crushed states. We surveyed twice within 4-hour primary periods to meet the model assumption of population closure, and marked all carcasses discovered using a GPS unit. We performed 62 primary surveys in May and June. Preliminary Least Tern raw counts included 31 adults or fledglings and 18 chicks. 6 plover carcasses were also found, as well as 45 non-waterbird carcasses. Independent surveys by Park Service staff detected 25%–33% of known quail carcasses and 60% of known tern carcasses. Most quail carcasses were undetectable after one day. Analysis of the robust design model will be concluded by the end of the summer.

### **Impact of the time of day on flight and distribution patterns of Lesser Black-backed Gulls *Larus fuscus* at sea**

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Detailed knowledge of individual flight and foraging patterns of seabirds can help to indicate possible changes in the marine environment. Among wind and tides, time of day is assumed to affect flight activity and at-sea distribution of several seabird species. Previous studies indicating a clear correlation of time of day with the flight behaviour of seabirds primarily using data from standardized ship or plane based seabird surveys. As small GPS dataloggers yield extremely detailed information about flight and foraging paths, it is now possible to analyze such relationships for single individuals. This study aims to identify daytime rhythms in the flight patterns of Lesser Black-backed Gulls *Larus fuscus*, LBBG, equipped with GPS dataloggers. The LBBG is a common breeding bird of the southern North Sea. Individuals forage both at sea, mainly feeding on swimming crabs and fishes, and on land, preying mainly on invertebrates and small mammals. In this study, we primarily compare flight and foraging patterns of logged LBBG from different colonies with their at-sea distribution as revealed from plane based surveys of the FTZ seabirds at sea database (2002–2012). Do the individual flight patterns explain their flight distribution at sea during breeding season? We used results of logger studies from several German North Sea islands: Helgoland, Spiekeroog, Amrum and Borkum. Generalized Linear Mixed Models revealed that distance to nest was significantly influenced by time of day, colony and flight destination (land/sea). When foraging at sea, gulls were either in the nearshore zone during twilight and night or farther offshore

during the daylight hours or vice versa. Overland flights were performed predominantly during the day, but depending on the distance to colony, gulls stayed the night on land or flew back to the colony.

### Does pollution relate to foraging ecology patterns? Insights into the waterbird community from the Ebro Delta

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Being one of the largest wetlands in the western Mediterranean region, the Ebro Delta presents a wide variety of habitats and is home to a rich waterbird community. At the same time, the anthropogenic pressure has negative effects from both, large scale processes (pollution on the river catchment area, water consumption, river management, alteration of geological delta dynamics) and local anthropic alterations (agriculture and land management). Aiming to provide new insights on the link between ecological traits and several trace metal burdens, we analyzed eggs of selected species of Sternidae, Ardeidae, Laridae and Rallidae, as representatives of the breeding waterbird community. Trophic ecology, niche and habitat partitioning of this bird community was assessed using stable isotopes analysis (SIA) ( $\delta^{15}\text{N}$  and  $\delta^{13}\text{C}$ ) and ellipse-based niche metric (SEAc). Mercury, selenium, copper, lead, cadmium, antimony, chromium and arsenic levels were measured, to ascertain whether values are of conservational concern. Results show that Common and Sandwich Tern behave as strict specialists, having narrow niche widths, while Little Tern, Little Egret, Purple Heron, Night Heron and Moorhen behave as generalists foragers, with higher niche widths. The measured levels of selenium, copper, lead, cadmium, antimony and arsenic are out of conservational concern and range within the values found in other bird communities, while chromium levels are higher for all species and habitats, but still below toxic levels. For species foraging mainly on marine resources, as Audouin's Gull, Little Tern and Common Tern, mercury levels in eggs are much higher at the Ebro Delta and further studies must be addressed to ascertain whether these values are endangering their breeding success. Arsenic, specially when used in combination with  $\delta^{13}\text{C}$ , discriminates outstandingly between marine and freshwater species, with marine related species presenting higher levels of arsenic and carbon signatures.

### The influence of seabirds on Scottish islands; from guano to grass to grazing

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Potentially breeding seabirds can transfer nutrients from the marine ecosystem to their terrestrial breeding habitat, which

potentially causes significant effects within their nesting habitat. Consequently, these trans-boundary subsidies can drive ecosystem processes and influence the vegetation and herbivores in seabird nesting habitat. The present study looks at the effect of seabirds on the habitat they nest in on two Scottish islands, Mingulay and Hirta and over two years. It focusses on the impact of Atlantic Puffins *Fratercula arctica* and Great Skuas *Stercorarius skua* upon vegetation and the flow of marine-derived nutrients into mammalian herbivores. The two species represent two types of nesting habit with a burrow- and one surface-nesting species, respectively. Bioenergetic models show that seabirds can transfer substantial amounts of marine-derived nitrogen onto the terrestrial habitat. Nitrogen transferred from seabirds to the vegetation of their nesting habitat is identifiable through their enriched stable isotope ( $^{15}\text{N}$ ) signature compared to terrestrial nitrogen sources. We will analyse for variation in  $^{15}\text{N}$  enrichment relative to control areas without seabirds and in relation to seabird species, locality and year. The enriched vegetation within seabird colonies also corresponds to an enriched  $^{15}\text{N}$  signature of mammalian hair, relative to control samples. This study thus shows a novel example of how nutrients deposited seasonally by seabirds not only permeate into vegetation but also into mammalian herbivores. This temporal subsidy, often reported with increased vegetative quality and growth, suggests that seabirds could benefit herbivores in a nutrient-limited environment and any change in seabird populations could result in the alteration of terrestrial ecosystems.

### Contaminant Exposure in Waterbirds Nesting in Green Bay, Wisconsin, USA

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Elevated polychlorinated biphenyl (PCB) and p,p'-dichlorodiphenyldichloroethylene (DDE) concentrations were reported in Double-crested Cormorants *Phalacrocorax auritus*, Black-crowned Night-herons *Nycticorax nycticorax*, and Tree Swallows *Tachycineta bicolor* nesting in lower Green Bay, Wisconsin, USA in the early 1990s. Comparable samples collected in 2010 and 2011 indicated that concentrations of PCBs were 39%, 70%, and 88% lower than in the early 1990s in Tree Swallow, Double-crested Cormorant, and Black-crowned Night-heron eggs, respectively; concentrations of DDE were 52%, 51% and 51% lower, respectively. The degree to which these declines reflect earlier dredging activities on the Lower Fox River or natural attrition is unknown. Concentrations of PCBs were higher in Herring Gull *Larus argentatus* (6.9 ppm) than Black-crowned Night-heron eggs (1.3 ppm) collected from Green Bay in 2010; Double-crested Cormorant (3.5 ppm) and Tree Swallow eggs (2.0 ppm) were intermediate. The toxicity of the PCB mixture was equal or greater in eggs of the insectivorous Tree Swallow than the three higher trophic bird species. Higher concentrations of PCB congener 77 in Tree Swallow eggs were responsible for the differences in toxicity patterns between Tree Swallows and the three other species. The percent composition of lower numbered PCB congeners was greater in Tree Swallow eggs than three other species nesting in Green Bay. Dioxin and furan concentrations and the toxicity of these chemicals were also higher in Tree Swallows than other bird species nesting in Green Bay. Concentrations of 2,3,7,8-TCDF was a major contributor to the differences in toxicity between Tree Swallows and the other bird species.

## Seasonal abundance patterns of prey fish explain breeding phenology of Common Terns *Sterna hirundo* in the Wadden Sea

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The seasonal decline of reproductive success is commonly observed in many bird species. The interplay between environmental conditions and parental quality is discussed as the underlying cause, but the crucial environmental factors eventually driving the pattern are poorly understood. We related the size-specific energy content per unit water volume of three main prey fish species during the courtship period of Common Terns *Sterna hirundo* breeding in the Wadden Sea with the date of egg laying. Additionally, we used diet composition during the courtship and chick rearing period along with meteorological data to approximate conditions later in the season, explaining chick growth and breeding success. The onset of egg laying was inversely related with the energy made available through Sprat *Sprattus sprattus* and Herring *Clupea harengus* during courtship, while the energy provided by the most frequently eaten prey fish Smelt *Osmerus eperlanus* did not have an effect. This pattern did not reflect the relative abundance of the three main prey fish species in the terns' diet, indicating that the energetic cost of catching different prey fish is species-specific and cannot be explained by size and abundance alone. Later in the season, breeding success appeared to be compromised by adverse weather conditions in some years. In other years, high water temperatures may have caused emigration of key prey fish species out of the foraging range of the colony-bound terns. Against the background of the start of egg laying, factors affecting prey availability and, thus, chick development and breeding success, are discussed and summarized in a conceptual model.

## Olfactory foraging in temperate waters: Sensitivity to dimethylsulfide by shearwaters in the Atlantic Ocean and Mediterranean Sea

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Many procellariiforms use olfactory cues to locate food patches over the seemingly featureless ocean surface. In particular, some of them are able to detect and are attracted by dimethylsulfide (DMS), a volatile compound naturally occurring over worldwide oceans in correspondence with productive feeding areas. However, current knowledge is restricted to sub-Antarctic species, and to only one study realized under natural conditions at sea. Here, for the first time, we investigated the response to DMS in parallel in two different environments in temperate

waters, the Atlantic Ocean and the Mediterranean Sea, employing two sister species, Cory's Shearwater *Calonectris borealis* and Scopoli's Shearwater *Calonectris diomedea*, as models. To test whether these birds can detect and respond to DMS, we presented them with this substance in a Y-maze. Then, to determine if they actually use this molecule in natural conditions, we tested the response to DMS at sea. The number of birds that chose the DMS in the Y-maze and that were recruited at DMS-scented slicks at sea suggest that these shearwaters are attracted to DMS in both non-foraging and natural contexts. Our findings show that the sensitivity and attraction to DMS are actually widespread among petrel species and different marine environments, including temperate waters. Our study opens a worldwide perspective to previous hypotheses concerning the use of DMS as a cue for foraging and as a chemosignal, providing experimental basis to theoretical work.

## Delayed colony formation in the Black-headed Gull *Larus ridibundus* results in escalating competition, female starvation and decreasing of reproductive output: the results of a 'natural experiment'

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In South Siberia Black-headed Gulls form their colonies during 3–4 weeks, and they compete strongly for nest sites. Late nesting birds incur high energy costs associated with delayed reproduction. We estimated the effect of the timing of nesting under the circumstances of the natural experiment when April appeared to be extremely cold in 2008. We compared the timing of nesting, sizes of defended territories, behaviour and reproductive parameters of Black-headed Gulls in "abnormal" 2008 and "normal" 2007 and 2009. Territory sizes were tested with the use of a remotely controlled stuffed gull. It turned out that in 2008 colony formation started 8–10 days later, the period of formation was 5 days shorter, and the distance between nearest nests was twice as large as in "normal" years. Although sizes of defended territories did not change in 2008, residents demonstrated much higher anxiety and left their clutches twice as frequently. Weight of incubating females also did not change, however, the characteristic timing-effect when low-weight females breed later in the season was not displayed in 2008. Clutch size, mean egg volume and mean hatchling head length were, correspondingly, 1.14, 1.05, and 1.49 times less in 2008, and hatching success decreased 1.5 times due to predators. So, in the natural experiment, gulls ready to reproduce started to compete for nest sites later. This caused escalation of competition and formation of low density colonies. Prospective benefit decreased, and energy costs associated with territorial conflicts increased in the "abnormal" year, and all members of the colony suffered from the delayed nesting. It is likely that "normal" formation of colonies optimizes allocation of parental effort, defense of the territory, laying eggs and protection from predators and thus allows Black-headed Gulls to elicit maximal benefit from colonial breeding.

## Comparing trail cameras and video systems for Snowy Plover nest monitoring

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Many ground-nesting birds are subject to a suite of nest predators during incubation. Typically, researchers must rely on tracks and signs at the nest to determine cause of loss. However, weather, substrate type, and monitoring frequency can make correctly identifying nest predators difficult. Other animals may subsequently be attracted to the depredated nest, further complicating identification. We field-tested two camera types for monitoring Snowy Plover *Charadrius nivosus* nests to identify causes of nest loss. We used infrared trail cameras placed at nests at Gulf Islands National Seashore, FL. The cameras took photographs once per minute, or when motion-triggered. We also deployed three video monitoring systems on Snowy Plover nests at Tyndall Air Force Base, FL. These were infrared security cameras contained inside plastic buckets, which ran on batteries and recorded to a portable DVR. The unit was completely self-contained and took continuous video of nests for up to 4 days. While trail cameras are less expensive and require minimal assembly, we found that they were not sensitive enough to fully capture nest depredation by other birds. We also suspect that cameras were not always triggered by ghost crabs depredating nests. However, reviewing the continuous video footage proved to be more time intensive than the trail camera stills. Both camera types succeeded in capturing mammalian predators at nests, and both ultimately revealed the identity of a nest predator that differed from what was identified using tracks. The best camera type for a particular study should take into account cost, predator type at a site, and time investment for footage review.

## Impacts of anthropogenic disturbance on Snowy Plover reproductive success and behavior in Northwest Florida

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Snowy Plovers *Charadrius nivosus*, state-threatened shorebirds that breed and winter in Florida, are subject to human-caused disturbance due to the proximity of their habitat to coastal development and recreation. The effects of disturbance on Florida Snowy Plover behavior and reproduction have not been fully evaluated, nor has the efficacy of current disturbance mitigation efforts. Our objective was to examine the relationship between reproductive success, behavior and disturbance through monitoring of plovers at sites experiencing a gradient of anthropogenic impact. At six sites across Northwest Florida, we uniquely marked adult plovers with colored leg bands, and recorded all nest and brood activity of all plovers in the study area. Activity budgets were conducted to determine time allocation to different behaviors by plovers during pre-breeding, incubation, and brood-rearing periods. We recorded Snowy

Plover responses to different types of disturbance, as well as response distances and durations, during focal observations of interactions between plovers and disturbances. We calculated nest survival using logistic exposure, and chick survival using mark-recapture methods. Preliminary results indicate that Snowy Plovers respond differently to human and natural disturbances, and that we can identify distance thresholds for responses to different sources of disturbance. We found significant site-specific differences in chick survival, with the lowest survival at the site with the most human impact. We did not find any significant difference in nest success between sites. This may indicate that reduced chick survival is the mechanism by which anthropogenic disturbance impacts Snowy Plover reproduction in this system. Further results from this study will shed light on the relationship of anthropogenic disturbance to Snowy Plover behavior, specifically whether reduced chick survival is associated with changes in parental behavior in the presence of disturbance.

## Spatiotemporal dynamics of a threatened shorebird: the roles of dispersal, climate, and management

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Understanding metapopulation dynamics is critical for effective conservation of threatened species, especially since spatially synchronous populations are less likely to persist. Spatial synchrony is driven by dispersal, environmental synchrony (i.e. "Moran Effect"), and management. However, mechanisms such as density-dependent dispersal, microclimates, and small scale variation in land ownership may desynchronize these trends. The variety of these driving processes across multiple spatial scales means that for wide-ranging species, patterns of spatial synchrony and the underlying mechanisms driving those patterns might vary across the range. We took advantage of range-wide monitoring and management of the threatened western Snowy Plover *Charadrius nivosus nivosus* to examine how the impact of synchronizing mechanisms on plover populations varies over large spatial scales. Our main objectives were to assess (1) if spatial synchrony is consistent with dispersal, a Moran effect, or correlated management, and (2) if the roles of different drivers of synchrony vary among the northern, central, and southern regions of the U.S. range. We found that winter climate hindered population growth in the northern region of the range, whereas in the south, management was more important, with predator removal and exclosures having positive and negative effects, respectively. Regionally, we only found evidence of spatial synchrony in the south. There was no evidence of a Moran effect. The decay in spatial synchrony in the south occurred over a similar spatial scale to that of adult breeding dispersal and, furthermore, neighboring populations with similar management practices were more likely to be synchronous. Our findings suggest that density dependent dispersal and variation in land ownership could be desynchronizing growth in the northern and central regions where populations are small and are located within a variety of arbitrary political areas that manage predators differently.

## The origin of banded Great Egrets *Ardea alba* encountered in the Caribbean Sea

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The Great Egret (henceforth egret) is a common breeding and wintering bird on many Caribbean islands, with many wintering birds coming from the North American mainland. Unfortunately, there are no studies which identify the specific origin of mainland egrets encountered in the Caribbean islands, which is the goal of this study. All records (N=78) of banded egrets encountered on the Caribbean islands, and details of egrets banded in each state/province of origin were obtained from the Canadian Wildlife Service. Banded egrets were encountered in Cuba (40), the Dominican Republic (16), the Lesser Antilles (9), Jamaica and St. Croix (5), and the Bahamas and Puerto Rico (4 each). They had been banded in New Jersey (18), Mississippi (16), Virginia (10), Ohio (9), Maryland (7), South Carolina (6), Ontario (4) and North Carolina, Rhode Island, Florida, New York, Minnesota, Connecticut, Alabama and Wisconsin (1 each). With the exception of Florida, all jurisdictions with more than one egret encounter had banded between 1,174 and 2,924 egrets and all with a single encounter had banded fewer than 439 egrets; Florida had banded 2,019. This suggests that many of the mainland egrets that migrate to the Caribbean islands come from colonies along the Atlantic coast of North America north of Florida as well as Mississippi. They also come from as far north as Ontario, Canada; birds from Florida appear unusually sedentary.

## The Study of Career Decisions: Oystercatchers as Social Prisoners

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Because resources are limited, animal populations cannot grow forever and the ensuing struggle for existence subjects them to the relentless force of natural selection (Darwin, 1859). Thus, competition among animals for limited resources is a defining property of life. In the case of our study species, the Oystercatcher, access to these limiting resources depends on their social position as a member of a social system or animal society. There are three descriptions of aspects of animal societies in terms of competition, each accompanied by their own body of theory: (1) Distribution theories describe the access of individual animals to limiting resources in space. (2) Life history theory describes the access of individual animals to limiting resources in the course of their life, and how these resources

are allocated to survival and reproduction. (3) Mating systems theory describes the access of individual animals to partners as a resource limiting reproduction. According to Wilson (1998), the ultimate goal of science is to unite different fields of knowledge and his term for this enterprise is consilience. Our modest contribution to consilience is the attempt to combine adaptive distribution theory to life history theory and mating systems theory to better understand the social organization of our study species. As Wilson (1975) formulated it nearly three decades ago: "The ultimate goal is a stoichiometry of social evolution. When perfected, the stoichiometry will consist of an interlocking set of models that permit the quantitative prediction of the qualities of social organization – group size, age composition, and mode of organization, including communication, division of labor, and time budgets – from a knowledge of the prime movers of social evolution." We will describe the progress we have made towards this goal in our 30-year study of an Oystercatcher population breeding on the island of Schiermonnikoog.

## Waterbirds community assessment of the San Juan Bay Estuary Program in Puerto Rico, USA

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This study assessed the Audubon Christmas Bird Count (CBC) of the San Juan Bay Estuary Program (SJBEP) during two periods (2000–2003, 2005–2006). We analyzed the waterbird composition and diversity from four transects (Cucharillas, Esperanza, Caño Martín Peña, and Bosque de Piñones) at the metropolitan area of San Juan in the Caribbean island of Puerto Rico. Birds' diversity was calculated using the Simpson diversity index for each site. Furthermore, the Puerto Rico GAP analysis of the United States Forest Service (USFS) was used to analyze the land cover (percent of natural wetland and urban development) within a 500-m buffer zone surrounding the observed transects. The CBC revealed a total of 5,666 individuals of 50 species belonging to 12 families of waterbirds. The most represented taxonomic families throughout the estuary were *Ardeidae* (10 species, 1,397 individuals) and *Charadriidae* (5 species, 833 individuals). The Simpson diversity index ( $\lambda = 0.9275$ ) for all sites combined shows a high bird community diversity. The statistical test of Kruskal-Wallis revealed significant biodiversity differences among the sites studied ( $p < 0.05$ ). The USFS GAP analysis displayed a positive relationship between the percent of mangrove forests and the number of birds observed. Variation in community composition found by site proposes that the San Juan Bay Estuary has a valuable assembly of habitats that safeguards the diversity of migratory and resident waterbirds in Puerto Rico. Management and education strategies are offered as recommendations to improve the monitoring of avifauna by the SJBEP and involvement of the local citizens in the process. Future studies of distribution, behavior and habitat use are essential to better understand the ecological factors influencing waterbirds' community composition in tropical wetlands.



## Double-crested Cormorant management: lessons learned at an urban wilderness area

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Managing abundant wildlife species which impart significant ecological change presents challenges to park managers and management options range in the degree of intervention. Double-crested Cormorants are a heavily managed species in North America. We describe three approaches used to address the challenges of a cormorant population at an urban park in Toronto, Ontario, where the primary issue is modification of habitat from forest to non-forest. We focus on the biological response of cormorants to three non-lethal management actions whose goal was to encourage nesting on the ground: deterrence in forested areas and its effects on non-target tree-nesting cormorants; conspecific attraction to models/playbacks; and restricting access to the ground-nesting colony. Deterrence activities in focal areas did not change the number of birds nesting and there was a carry-over effect on non-target cormorants based on an increasing shift of nest activity in trees away from the deterrent source. Over three years, a conspecific attraction effort using models/playbacks did not attract nesting birds. When the ground-nesting colony was restricted to nighttime visits by researchers, the ground-nesting colony grew from 1,009 to 6,986 nests (592%) over six years. Comparatively, the ground-nesting colony increased 8.8% (948 to 1,302 nests) when diurnal access occurred (5 yrs). We could not distinguish between the management action of restricting daytime disturbance to the ground colony and other factors that would shift cormorants move to ground nesting, such as relatively lower nest success in trees. Many cormorant ground-based colonies are oiled to reduce nest productivity, yet for conflicts which relate to habitat it may be better to allow ground-nesting colonies to function naturally and minimize disturbance to those sites.

## Survival and population growth of Sandwich Terns in a large Danish colony: any detectable response to culling of large gulls?

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The demography and population dynamics of terns are often poorly understood, largely due to their adaptation to dynamic breeding habitats, i.e. very frequent dispersal. Sandwich Terns are specialized breeders, which in Europe almost exclusively nest in colonies of Black-headed Gulls. Their fate is thus closely linked to that of their "host" species. Hirsholm in northern Denmark has hosted a very large Black-headed Gull colony (up to 32,000 pairs) for many decades, but in recent years this colony has declined strongly due to lack of food and competi-

tion with Herring Gulls. Furthermore, adult Sandwich Terns as well as eggs and young were exposed to predation by Great Black-backed Gulls and Herring Gulls. This led to concern about the impacts on Sandwich Terns, which have nested at the islets since at least 1936 with up to 3,500 pairs, and since 2007 management efforts have included culling of the breeding large gulls. Consequently, the number of breeding Herring Gulls declined from 400 pairs in 2007 to 20 pairs in 2012, and predation became a rare event. The number of breeding Sandwich Terns increased from 818 pairs in 2006 to 1600-1800 in 2009-2013. Very few survival estimates exist for Sandwich terns, largely due to their nesting habits. We used resightings of metal-banded terns resting on boulders immediately outside the colony to estimate annual adult survival from 2003-2012. The data were extremely heterogeneous, and we explored various approaches to compensate for this. Mean annual survival was estimated as around 0.86, with substantial annual variation. This is slightly lower than expected, which may reflect some level of emigration of breeders even from this relatively stable colony. There was little indication that survival increased after culling of large gulls was introduced, but it appeared that there was a decrease in temporary emigration from the colony. However, the observed increase in colony size was likely mainly due to recruitment of new breeders.

## Stealing food from conspecifics: spatial behavior of kleptoparasitic Common Terns *Sterna hirundo* within the colony site

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Parasitic interactions over food are one of the most widespread forms of exploitation within and among species and there is a vast body of literature describing the many forms of such behavior (e.g. kleptoparasitism). Kleptoparasitism is a form of competition that involves stealing food already procured by another forager, and is one of the most common types of exploitation in seabirds. Here, we analyzed the spatial movements of individuals transponder-marked Common Terns *Sterna hirundo* within the colony site during the chick rearing period, supplemented by foraging observations, in relation to the trophic strategy (namely kleptoparasitic vs. honest birds). Attendance pattern (time spent at colony site per day, number and location of resting platforms used) were compared between kleptoparasitic (n=11), and honest individuals (n=26). A total of 725 kleptoparasitic attacks were recorded during the chick rearing period. We found differences between genders in the tactic used to steal food and the area chosen to perform the attacks: females attacked in the vicinity of their nest, while males attacked further away. We found clear differences in the spatial pattern between both groups: kleptoparasites used more resting platforms and moved more widely across the colony site than honest individuals, and parasitic females were registered longer in the colony during the day than honest ones. Our results show a differential use of the colony site dependent on the foraging strategy. Parasitic birds use the colony as a foraging patch, exploring the colony looking for feeding opportunities (i.e. kleptoparasitic attacks). In contrast, honest individuals spend much time outside the colony foraging to feed their chicks.

## Movements and survival of juvenile Reddish Egrets on the coastal Gulf of Mexico

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The Reddish Egret *Egretta rufescens* is a plumage-dimorphic, medium-sized heron species found along the coastal Gulf of Mexico and Pacific coast of Mexico in North America as well as the Caribbean and parts of Central America. The primary objective of our research was to examine the movement behavior and estimate survival of juvenile Reddish Egrets hatched on the Texas coast. We tracked a cohort ( $n = 25$ ) of juvenile Reddish from June 2010–August 2012 using satellite telemetry. We captured and placed transmitters on 14 dark morph and 11 white morph birds; 21 of the birds were male and 4 were female. Total distance traveled through the entire study averaged 1105.29 km ( $\pm 178.64$  km), or 2.50 km/day ( $\pm 0.46$  km/day). The birds' maximum distances traveled from their natal colonies averaged 241.29 km ( $\pm 62.31$  km). Neither body condition nor morph was found to have a significant effect on any of the movement measurements. At the end of the observation period, eight of the original twenty-five transmitters were still reporting location data, resulting in an overall survival estimate of  $0.32 \pm 0.18$ . Comparisons between morphs, sexes and colonies detected no significant differences in survival between subgroups. Overall, variation in dispersal and movement measurements exists mostly among individual birds. Our results suggest that mortality in juvenile Reddish Egrets is rather high, and could be the life stage that limits overall population growth. Our research coupled with future research on the movement ecology of Reddish Egrets will contribute substantially to the understanding and conservation of North America's rarest and most unique heron species.

## Seabirds are whale watchers: the influence of cetaceans on the distribution of Northern Gannets in the Gulf of St Lawrence, NW Atlantic Ocean

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Marine predators have to rely on behavioral techniques to effectively locate and access their patchily distributed prey. Local enhancement is an important mechanism for foraging avian generalist predators, particularly during reproduction when energetic demands are high and foraging ranges limited. We studied the foraging behavior of Northern Gannets *Morus bassanus* in the Lower Estuary and Gulf of St. Lawrence (NW Atlantic) during the breeding period with ship-based surveys. At least 21.6% ( $n=3,452$  ind.) of all Gannets were associated with natural phenomena. A majority of these birds (15.8% of all,  $n=2,525$  ind.) occurred in groups associated with natural feeding associations. These were dominated by multi-species feeding associations and/or associations with marine mammals (15% of all). Cetaceans (58% occurrence) and particularly

dolphins (33% occurrence) such as the Atlantic White-sided Dolphin *Lagenorhynchus acutus* were dominant producers in natural feeding associations. Northern Gannets were hardly associated with fishing vessels (0.4% of all,  $n=66$  ind.). Spatial analysis revealed a significant and close spatial association between Gannets and cetaceans. 25% of Gannets occurred within 0.3km, 50% within 2.9km (=median distance,  $n=8766$ , 20km radius) to the nearest cetacean. Cetacean abundance proved the largest effect ( $F=138.81$ ) of all significant predictors when modeling Gannet abundance with a generalized additive model. The strong link between Gannets and cetaceans emphasizes the role of local enhancement for foraging of Northern Gannets. The high abundance of foraging cetaceans which drive and keep suitable prey, mainly pelagic fish, in water depths exploitable by Northern Gannets, are likely a key mechanism for the latter. This relationship might support the outstanding numbers of breeding Gannets found in the Gulf of St. Lawrence.

## Long-term changes in goose migration phenology in the Hortobágy (Hungary)

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The Carpathian basin is a traditional migrating and wintering area of several Eurasian wild goose species. The Hortobágy National Park is a stopover place along the flyway, in which typical habitats are grasslands and wetlands surrounded by agricultural fields. The most numerous migrating goose species is the White-fronted Goose *Anser albifrons*, but flocks of the endangered Lesser White-fronted Goose *Anser erythropus* and Red-breasted Goose *Branta ruficollis* are also observed each year. The Greylag Goose *Anser anser* is the only breeding goose species in the area and regular in the migration periods as well. Hungary has a temperate continental climate under Eastern-European continental, Western-European oceanic and Mediterranean influences. The temperature and snow conditions in the time of goose migration and wintering fluctuate within a wide range, caused by the diverse effects and the basin character. We analysed the correlation between the average monthly temperature and snow cover and the number of wintering geese between 1989 and 2013. Our results showed a significant increase in the number of overwintering geese, and we have found several phenological changes in the timing of goose migration.

## Rags to Riches: post-flood demography of Piping Plovers in the Great Plains

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Changes in the natural flow regime associated with the installation of dams in the mid-twentieth century have reduced the sandbar nesting and brood-rearing habitat for Piping Plovers *Charadrius melodus* on the Missouri River. In 2005, the U.S. Army Corps of Engineers began engineering sandbar complexes on the Missouri River to restore habitat for Piping Plovers and Least Terns *Sternula antillarum*. From 2005–2011, we compared the performance of the engineered sandbars and

those that naturally occurred on the river by measuring Piping Plover prey abundance, nest success, pre-fledge chick survival and adult survival. During the breeding season of 2011, a record-breaking flood covered virtually all potential nesting habitat and resulted in high adult mortality and negligible productivity. Despite these negative effects, the flood created an abundance of sandbar habitat, and we evaluated the response of Piping Plovers to this new resource. Our results indicate that post-flood sandbars perform better than both pre-flood engineered or naturally occurring sandbars. Apparent nest success, pre-fledge chick survival, and adult survival are all higher on post-flood sandbars as compared to both pre-flood engineered and pre-flood naturally occurring sandbars. However, prey abundance on post-flood sandbars is not significantly different from either pre-flood sandbar type. These results will help managers create and protect habitat for Piping Plovers.

### **Factors affecting Saltmarsh Sparrow *Ammodramus caudacutus* nesting density and reproductive success in New York City: implications for tidal marsh management action plans in urban areas**

**Alison R. Kocek<sup>1,\*</sup>, Jonathan Cohen<sup>1</sup>  
& Susan B. Elbin<sup>2</sup>**

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Sea level rise and anthropogenic factors have accelerated tidal salt marsh loss along the eastern seaboard of the United States. The Saltmarsh Sparrow *Ammodramus caudacutus* (SALS), a tidal marsh obligate species, has mirrored this decline and is considered a species of highest conservation priority, and was recently placed on the 'Vulnerable' list by IUCN. Habitat characteristics of sites with reproductively successful SALS must be quantified to inform marsh restoration plans for these imperiled birds; New York City has ongoing restoration projects. We surveyed 11 marshes in NYC for SALS nesting presence. SALS bred at three sites, at which bi-weekly systematic nest searching and nest checks were performed. At all sites, monthly invertebrate sweep-net sampling, monthly vegetation sampling, and regular ten-min disturbance surveys were performed. SALS nesting presence in NYC cannot be explained based upon machine noise or prey abundance, or abundance of high elevation vegetation species within a marsh. Abundance of avian nest predators and highly urbanized marsh borders significantly affect nesting presence of SALS in NYC. SALS are 3.985±1.684 times less likely to use a marsh for nesting if the marsh surroundings are >40% urbanized even if marsh area and vegetative structure appear adequate. SALS in NYC preferred nest sites in tall vegetation (*Spartina alterniflora*) located in low elevation areas, to traditional nest sites in short vegetation (*S. patens*) in high elevation areas. This preference potentially leaves nests more exposed to predation than traditional SALS nesting schemes. Further analysis is pending to support a correlation between unusual SALS nest vegetation preferences and avian predator avoidance.

### **Response of saltmarsh sparrows to a highly urbanized environment: factors affecting nesting presence in New York City**

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Sea level rise and anthropogenic factors have accelerated tidal salt marsh loss along the eastern seaboard of the United States. The Saltmarsh Sparrow *Ammodramus caudacutus* (SALS), a tidal marsh obligate species, has mirrored this decline and is considered a species of highest conservation priority, and was recently placed on the 'Vulnerable' list by IUCN. Habitat characteristics of sites with reproductively successful SALS must be quantified to inform marsh restoration plans for these imperiled birds; New York City has ongoing restoration projects. We surveyed 11 marshes in NYC for SALS nesting presence. SALS bred at three sites, at which bi-weekly systematic nest searching and nest checks were performed. At all sites, monthly invertebrate sweep-net sampling, monthly vegetation sampling, and regular ten-min disturbance surveys were performed. SALS nesting presence in NYC cannot be explained based upon machine noise (ANOVA,  $F_{9,85}=3.32$ ,  $P=0.26$ ) or prey (ANOVA,  $F_{10,22}=0.95$ ,  $P=0.51$ ) abundance, or abundance of high elevation vegetation species within a marsh. Abundance of avian nest predators (ANOVA,  $F_{9,85}=5.41$ ,  $P<0.0001$ ) and highly urbanized marsh borders (Logistic Regression,  $DF=47$ ,  $P<0.001$ ) significantly affect nesting presence of SALS in NYC. SALS are 3.985±1.684 times less likely to use a marsh for nesting if the marsh surroundings are >40% urbanized even if marsh area and vegetative structure appear adequate. SALS in NYC preferred nest sites in tall vegetation (*Spartina alterniflora*) located in low elevation areas, to traditional nest sites in short vegetation (*S. patens*) in high elevation areas. This preference potentially leaves nests more exposed to predation than traditional SALS nesting schemes. Further analysis is pending to support a correlation between unusual SALS nest vegetation preferences and avian predator avoidance.

### **Changes in corticosterone level and heterophils/leukocytes ratio in the Little Auk *Alle alle* in response to capture and handling procedures**

**Izabela Kulaszewicz<sup>1,\*</sup>, Katarzyna Wojczulanis-Jakubas<sup>1</sup>, Olivier Chastel<sup>2</sup> & Dariusz Jakubas<sup>1</sup>**

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Blood-based estimation of corticosterone concentration (CORT) as a proxy of the baseline stress level in wild-living birds may be constrained by the stress associated with the capture and handling procedures. To reliably assess the baseline CORT, the bird needs to be sampled within three minutes after the capturing. In contrast, ratio of heterophils to leucocytes (H/L), that is also considered to describe the bird's stress level, does not change up to 1 h after capturing. However, the time-window of the changes both in CORT and H/L may be species-



specific. Here, we examined the changes in these two variables in a small seabird, the Little Auk using a standard capture-restraint protocol. We collected blood samples twice (up to 3 min after the capture and after 30 min of restraint) from 50 adults during the chick rearing period in Hornsund (Spitsbergen). We found differences in CORT between the two set of samples, with tenfold increase of the values at the second sampling. There were no differences in H/L between 3 and 30 min after capture. We did not find any correlation between CORT and H/L at either the first or second sampling. Results confirm reports from other groups of birds (passerines, penguins) – CORT changes more rapidly after capture than H/L. In the field, where there is sometimes no opportunity to collect blood samples in less than three minutes after birds capture, H/L might be a reliable alternative for measuring the birds stress level.

### A review of historical and ongoing vegetation management for ground-nesting seabirds in northern Atlantic breeding colonies

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Although the tendency of nesting seabirds to modify the vegetation in their breeding colonies has been well-studied, researchers have rarely addressed the loss of nesting habitat that results from vegetation overgrowth. In the northern Atlantic, where many seabird colonies are recently restored or resurgent, this loss represents a major and growing threat to already limited nesting habitat. Seabird colony managers, limited by manpower and funding, generally manage vegetation on an as-needed basis with little study or monitoring. Meanwhile, little published research is available to guide management efforts, leading managers to take a trial-and-error approach over many seasons in search of techniques that are effective and feasible given the ecological sensitivity, difficulty of access, and temporal and spatial limitations of most seabird breeding colonies. By surveying colony managers and collecting published research, I gathered a summary of past and ongoing vegetation management techniques used on seabird nesting colonies in the North American and European northern Atlantic, including their costs, methods for application, and effectiveness, as a reference for managers within and outside the region. While effectiveness of different techniques varied between colonies, the greatest long-term improvement in habitat appeared to result from covering, rather than treating, existing vegetation. Sand, gravel, flagstone, and landscape fabric applications represented a high initial investment, but could be effective over multiple seasons with low-cost maintenance such as hand-weeding. Post-emergent techniques such as burning, mowing, saltwater treatment, and herbicide applications were some of the lowest-cost options but typically lasted a single breeding season at most, often overgrowing before fledging. Pre-emergent treatments such as soil sterilization or soil removal were rarely applied due to high costs, but may represent a possibility for future study.

### Do Night Herons *Nycticorax nycticorax* differ in terms of their migration strategy from other herons?

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Night Herons are long-distance migrants. Migratory movements of Night Herons from the Upper Vistula Valley (Poland, Europe) were studied by Ecotone GPS/GSM-tracking systems. Three adult birds were fitted with transmitters in late July and early August 2012. During the pre-migratory period, birds spent night and daylight hours at the feeding sites, mainly on carp ponds in the Upper Vistula Valley. Two birds started migration in September, one in late October. The detailed migratory behaviour between the Upper Vistula Valley and stopover areas was determined only for two birds. Birds followed the southern migratory route, towards Slovakia, Hungary and the Balkans and reached Italy. Birds migrated mostly at night with speeds of about 40 km/h, but the maximum recorded speed between two points at an interval of six hours reached 56 km/h. One bird reached middle Italy (distance exceeding approx. 900 km) during two nights, the second bird reached Sicily during three nights (distance exceeding approx. 1,500 km) where it spent a few weeks. After that, we were able to track the first bird only, which spent the second half of September in Middle Italy, October in Corsica, and the first half of November in Northern Algeria. The bird probably died during its flight over the Sahara Desert towards its wintering area. Our results show a yet undescribed autumn migration strategy of Night Herons with a long stopover en route, unlike Purple Herons. Due to the small sample size these results should be treated as tentative until more data are collected.

### Comparison of dietary sampling methods for nesting California Least Terns *Sternula antillarum brownii* at Alameda Point in San Francisco Bay and Purisima Point on the central California coast

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The California Least Tern *Sternula antillarum brownii* is a small, colonial seabird that breeds in beach and estuarine habitats along the coast of California. Understanding the relationship between diet and reproductive success is important for the effective management of this endangered species. Accurate dietary data are crucial for assessing this relationship. However, past studies of Least Tern diet have used multiple sampling techniques, making it difficult to compare diet among nesting colonies and track changes through time. To better understand the benefits and shortcomings of different techniques, we compared Least Tern diet over the last decade at two colonies: Alameda Point (34° N, 120° W) in San Francisco Bay and Purisima Point (37° N, 122° W), on the central California coast. We analyzed diet for the first site using fecal samples and dropped fish from 2000–2012 and for the second site using



fecal samples, regurgitated pellets and dropped fish from 2000–2012. Based on Spearman rank correlations, fecal samples and dropped fish yielded similar results at Alameda Point (< 0.05) but different results at Purisima Point (> 0.1). At Purisima Point, the most frequently dropped prey items were deep-bodied surfperches, which might be difficult for the chicks to consume because of their size. Initial analysis of prey size for each sampling method at Alameda Point show that dropped fish were larger than those present in fecal samples (two-tailed t-test, p-value  $\leq 0.01$ ). While species composition using the two methods is similar at Alameda Point, dropped fish might represent larger, more difficult to swallow prey. This study should contribute to a greater understanding of dietary assessment methods for Least Terns.

### Maps, models, and marine threats: assessing the geographic patterns of vulnerability of Atlantic Canadian seabirds at sea

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Whether dealing with the cumulative impact of chronic, small-size oil discharges or accidents associated with marine traffic and offshore oil and gas development, seabirds face a variety of threats in the marine environment. Assessing the vulnerabilities of seabirds to maritime hazards requires an understanding of their spatial distribution, and a means for combining this information across species groups. Using at-sea survey data gathered as part of a regional monitoring program, an efficient framework for integrating multiple species data was developed. Density estimates, derived from counts of species known to be particularly vulnerable to oil pollution, were used to construct multiple species distribution models (SDMs). The structural difficulties associated with sampling sparsely distributed individuals that can also occur in large, localized concentrations led to the use of three modelling techniques potentially well suited for this type of data: negative binomial, “hurdle”, and random forest methods. Predicted abundances were combined to produce an ensemble forecast, and multi-species composite vulnerability maps developed to identify core areas. The composite map confirmed the general importance of the shelf break and sea banks, but usage (and hence, vulnerability) was highly seasonally specific. A pattern of shifting presence emerged, with some species disappearing from the region (e.g. petrels and shearwaters in winter) and others increasing at the same time (e.g. Black-legged Kittiwakes *Rissa tridactyla*). Across all species, spring (March–April) stood out as a period of peak importance, though seasonal variation in the usage of the offshore marine environment may render the seabird community vulnerable to different threats throughout the year.

### The effect of land use on waterfowl habitat quality in an agricultural region of Atlantic Canada

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A recently published species distribution model (SDM) has shown a positive link between agricultural landscapes and breeding American Black Duck *Anas rubripes* in eastern Maritime Canada. This trend is contradictory to research in other parts of Canada. To better understand this connection, a more detailed multi-scale study was conducted in the summer of 2012 in the Annapolis Valley agricultural region of Nova Scotia. The goal was to determine the relationship between specific land uses and waterfowl habitat quality, and assess the impact on waterfowl breeding activity. Aerial surveys were conducted to count indicated breeding pairs (IBP) for thirty 2x2 km plots and predictions were made for both Mallards *Anas platyrhynchos* and Black Ducks using the published Maritime model. Brood surveys were conducted for 61 wetlands within the plot boundaries. In addition, a sub-sample of 30 sites was tested for macro invertebrates and water chemistry values. High-resolution satellite imagery was collected for the study area and ground-truth surveys performed to support automated land cover classification. Given landscape characteristics, the model predicted high numbers of Black Duck IBP. However, IBP observations from the 2x2 km survey revealed a lower number of pairs and a concentration in the eastern coastal zone. By contrast, Mallard presence was strong and widely dispersed throughout the valley in excess of model predictions. Brood surveys found a total of 7 Black Duck broods and 47 mallard broods. As expected, the average brood size for both species declined throughout the study period. However, the overall number of mallard broods steadily increased with time whereas there was no prominent increase in Black Duck broods. Future work will include completion of a detailed land use map, which will be used to more closely examine the relationship between human activity and IBP survey results, brood numbers, invertebrate densities, and water chemistry values.

### Conflict between human and piscivorous birds and mammals at pond fisheries in western Poland: perceptions and management of wildlife damage

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Wild piscivorous animals are often blamed for damaging aquacultures, which may cause conflicts between them and humans. The aim of this study was to assess the occurrence and distribution of ichthyophagous birds and mammals that may adversely affect fisheries yield at fish ponds in western Poland. A



telephone survey with fish farmers concerning perception of inflicted damage, and use of preventive measures at pond fisheries was conducted in 2012–2013. Serious damage by wildlife was reported at 95% fish farms. More than one species was blamed for substantial damage at 48% sites. Serious damage was attributed primarily to Cormorants *Phalacrocorax carbo* (50% ponds), Otters *Lutra lutra* (46%) and Grey Herons *Ardea cinerea* (39%). Damage control measures were employed at 84% farms. The most popular were lethal controls, reported at 49% farms. Otters and Cormorants were the most persecuted species (in >40% fish ponds). Stun guns and firecrackers (at 45% fish ponds), network on ponds, fences made of concrete or wire (21%) were the commonest methods of pond protection. The survey indicated poor cooperation between conservation authorities and fish farmers. Farmers complained that they had not received any compensation for losses in fish farming, and they had not got permits to persecute harmful species. All species were more frequent in carp ponds (Cormorant 79%, Grey Heron 69%, Otter 68%) than in mixed or trout ponds. Presence of Cormorants and Grey Herons was determined by type of fish ponds. In case of Otter and Mink *Neovison vison* – type of fish ponds and water source, Great Egret *Egretta alba* – type of fish ponds and northing, gulls *Larus sp.* – water source.

### Thirty-two years of Monitoring Pollutants with Seabirds in the Wadden Sea

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As top predators of the aquatic environment seabirds accumulate persistent chemicals, which affect their physiology, reproduction and even survival. This can cause population declines, which have frequently been an indicator of environmental change. With respect to chemical pollution in the Wadden Sea, coastal bird eggs have proven to be an excellent monitoring system. Bird eggs are a favourable matrix as they indicate the local pollution, and in the long term they reveal temporal trends in the contamination of reproductive females and thereby in the environment. On the German Wadden Sea coast monitoring with seabird eggs to describe the environmental pollution with anthropogenic contaminants such as mercury and organochlorines (PCB, DDT, HCB and HCH) has been carried out since 1981 by the Institute of Avian Research. Under the framework of the Trilateral Monitoring and Assessment Program (TMAP) the geographical scale was broadened to include the international Wadden Sea. As top predators of the food chain in the Wadden Sea, Common Tern (*Sterna hirundo*) and Oystercatcher (*Haematopus ostralegus*) were chosen as indicator species. With a different feeding ecology – terns feed on small pelagic fish and crustaceans whereas Oystercatcher prefers mussels and worms – the diet of these two species represents major parts of Wadden Sea ecosystem. The results show in most cases a lower contamination level in Oystercatcher than in Common Tern eggs, due to their higher trophic levels. The most affected area by pollutants is the Elbe estuary caused by discharge of the river. The temporal trends 1981–2012 show a clear decrease in the contaminants' level, mainly during the early 1990s, due to industrial changes caused by the German reunification. But concentrations of many contaminants are still at a high level and in some cases recent increases are evident.

### Colony size is regulated by opposing selective pressures in the Common Tern

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The aim of this study was to investigate how different evolutionary pressures act on the colony size in a ground-nesting waterbird, the Common Tern *Sterna hirundo*. For this purpose we experimentally provoked formation of breeding colonies that varied markedly in size by providing attractive nesting substrates of different sizes (artificial rafts) at the site with limited availability of natural nesting habitat. The study took place at Jeziorsko reservoir, central Poland in 2012. We found that terns nesting in the larger colony (around 100 breeding pairs) had higher nesting success and their offspring had better survival rates in comparison to chicks raised in the smaller colonies (30–40 breeding pairs). This results suggest that large nesting aggregations of terns provide better safety against predators. In contrast, chicks raised in the smaller colonies had higher growth rates, were in better physical condition (higher hemoglobin concentrations) and showed lower levels of physiological stress (lower heterophil/lymphocyte ratios). In conclusion, it appears that colony size in Common Tern may be shaped by opposing selective pressures, which, in turn, suggests that optimal (with regard to fitness) colony size was likely to have evolved throughout evolutionary times in this species.

### Extra-pair paternity and intraspecific brood parasitism in the Whiskered Tern

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The aim of this study was to investigate the patterns of paternity in the Whiskered Terns *Chlidonias hybrida*. For this purpose, a set of novel microsatellite markers was developed and used to molecularly estimate rates of extra-pair paternity (EPF) and intraspecific brood parasitism (IBP) in the colony at Jeziorsko reservoir, central Poland. EPF was recorded in 8.1% of offspring from 11.8% of broods, whereas IBP was recorded in 4.7% of chicks from 10.0% of broods. We found no relationship between the timing of breeding and incidence of both strategies. However, there was a negative relationship between breeding synchrony and occurrence of offspring that were non-descendant from one or both of their putative parents. Such pattern of paternity was consistent with the 'guarding constraint' hypothesis, indicating a trade-off between intensified mate/nest guarding and engaging in alternative reproductive strategies under conditions of high breeding synchrony.

## Moon phase and its effects on predation intensity in Common Tern *Sterna hirundo* breeding colonies

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Predation of both adults and young has been known to limit bird populations and may be one cause of population declines for Common Terns nesting in the Great Lakes. Nocturnal predator activity in waterbird colonies, and thus predation intensity, may be influenced by moon phase because predators may determine the most productive time to hunt based on ambient light intensity. We hypothesize that under lower light conditions (i.e. new moon) the activity of ambush predators (e.g. night herons and owls), and the overall intensity of nocturnal predation, will increase because these predators are able to remain concealed and stay in the colony for longer periods of time. Conversely, we expect other hunters, such as mammals (e.g. foxes, raccoons and mink), to be relatively insensitive to moon phase because they rely less on concealment for effective hunting within large waterbird colonies. We used remote, infra-red, motion-sensitive trail cameras and temperature sensors in nests to monitor predator activity at one Common Tern colony in Lake Ontario and three colonies in northern Lake Huron from May to August, 2013. Cameras were erected at colonies during the terns' incubation period and retrieved when the majority of chicks were close to fledging. Moon phase on nights in which predators were present at colonies are compared to moon phase on nights when predators were not detected. We also report the frequency and diversity of predators detected at these Great Lakes colonies. These results are contrasted with similar data collected within Common Tern colonies in Manitoba in 2012 to elucidate the effects of moon phase for a wide range of predators.

## Waterbird monitoring in and above offshore waters of western Lake Michigan, Laurentian Great Lakes, USA

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The emerging development of wind power in North America may pose many challenges to the avian wildlife of the Laurentian Great Lakes Region in North America. Among these challenges include an array of as-yet-unknown effects on avian populations that use the airspace above the surface of the Great Lakes as well as the water surface and underwater resources. Assessing potential risks to birds utilizing the Great Lakes is key to moving forward with wind power development in this region. An ongoing program of fixed-wing twin-engine aircraft surveys have been conducted along transects 1.6 to 16 km off of the western shore of Lake Michigan from northern Illinois to the Door Peninsula of Wisconsin, over seven seasons from autumn 2010 to the spring of 2013, and ongoing into 2014. A double-observer protocol is utilized to help eliminate potential detectability concerns regarding survey results. Transects are oriented north-south as a fuel conservation strategy, and spaced 5 km apart throughout the surveyed region. The aircraft flew at 148 km/h ground speed following the mapped transects in alternating directions. Surveys were flown at a 100 m aircraft altitude in favorable weather for flying and observing. Long-

tailed Duck, Red-breasted Merganser, and Common Goldeneye are the three most abundant species found on surveys to date, with other waterfowl, loons, grebes, and several gull species also represented. Seasonality, distribution, and relationship to water depths will be presented.

## One man's joy is a seabird's sorrow? Northern Fulmars *Fulmarus glacialis* at an offshore wind farm construction site in the North Sea

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Associated with the construction of offshore wind farms in the German sector of the North Sea, the national approving authority demands environmental impact assessment studies. These multi-annual studies allow analyses of potential disturbance of seabirds occurring in the area of interest. Here, we present first results of monitoring seabird abundance in relation to the installation of an offshore wind farm (80 turbines à 5MW) in the North Sea focussing on the Northern Fulmar *Fulmarus glacialis*. This highly pelagic species is generally considered to be less vulnerable to potential adverse effects of offshore wind farms. Empirical evidence, however, is scarce. In the study area, fulmars occur throughout the annual cycle with peaking numbers during the breeding period. To compare the spatial distribution before (2004–2006 and 2008/2009) and during (2010 onwards) the construction, ship-based and aerial surveys following SAS-methods (seabirds at sea) have been conducted. The ship-based surveys covered a study area of 590 km<sup>2</sup> including the construction site (wind farm area) and its immediate vicinity as well as an area considered to be undisturbed by construction activities (reference area). Pre-construction, fulmars were more or less spatially homogeneously distributed in the whole study area with typical aggregations of feeding flocks. After the onset of construction, fulmars occurred at roughly the same densities in the reference area but were much less abundant at the wind farm construction site. Preliminary results of the aerial survey, covering a much larger area (2,600 km<sup>2</sup>), point in the same direction and will be complemented with current data. So far, our results suggest that fulmars may prefer undisturbed areas and are more vulnerable to disturbance due to construction of wind farm than previously thought. In the next years, ongoing investigations during operation of the windfarm will reveal if fulmars will adapt to the new situation.

## Living on the Edge: gulls and humans in offshore colonies

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Gull populations throughout New England have experienced significant declines in recent years. This decline has been most pronounced in inshore colonies, while some offshore colonies have remained stable or even increased. Great Duck Island, Maine is an 89-hectare vegetated island located 9.25 km from the mainland, while Mount Desert Rock is a 1.2-hectare granite ledge 19.5 km further offshore and is the most isolated island in Maine waters. Overall gull populations on Great Duck have remained stable, but areas with extensive researcher presence

have increased, while numbers on other areas of the island have declined. The gull population on Mount Desert Rock, although smaller than that on Great Duck, has increased markedly in the past five years. As on Great Duck, the greatest increases have been in areas of high researcher traffic. Even though gulls nesting on Mount Desert Rock and Great Duck Island use areas of high human disturbance, they have notably different responses to the people working and living among them. My study examines factors that may contribute to these differences in gull behavior. Most of the gulls on Great Duck Island respond to researchers with anti-predator behaviors, charging and alarm calling when researchers approach their nests. Gulls on Mount Desert Rock however have a comparatively benign response to people, in some cases allowing researchers approach within one meter of their nest without the resident bird showing alarm. I suggest that these differences stem from a closer proximity to people and hence chronic disturbance of gulls on Mount Desert Rock compared to the experience of birds on Great Duck. This close proximity may contribute to increased habituation and decreases in energy expenditure associated with aggression. Small, crowded offshore islands may thus serve as refugia for birds fleeing declining colonies closer to the mainland in spite of the presence of resident humans.

### **New approaches to monitor nocturnal burrow-nesting seabirds**

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Monitoring seabird populations is important to assess the viability of populations and the state of the marine environment. However, many oceanic seabirds nest in burrows and are strictly nocturnal at colonies. These birds cannot be counted visually and monitoring their abundance is very difficult. We present two approaches to monitor nocturnal burrow-nesting seabirds, and outline the advantages and challenges of each method. The first approach is based on spatially explicit capture-recapture models and is suitable for species that can be captured in mist-nets. We tested this approach by estimating the density of two storm petrel species on a small islet in the Azores, Portugal. During the breeding season we captured and ringed birds using a spatial array of 16 mist-nets distributed across the islet. Based on the capture and recapture of ringed birds, combined with the spatial coordinates of each mistnet, we were able to estimate breeding population size of both species. The number of mist-nets required for population assessment depended on the home range size of the species. Thus, the design of a population assessment based on mistnetting must be tailored to the mobility of the target species. The second approach is based on automated sound recording and is suitable for species that nest in inaccessible locations and are highly vocal. We deployed automated sound recorders to record seabird calls over the entire breeding season in 6 shearwater colonies in the Azores, and counted the number of occupied nests around each recorder. We encountered significant challenges in data processing due to the need for automatic detection of calls. Nonetheless, we found a significant positive relationship between the mean calling rate and the number of shearwater nests around each recorder, indicating that acoustic recording may be useful for population monitoring. For many remote and inaccessible islands, automated recording may be a promising option to monitor seabird population.

### **Caspian Terns adopt and successfully raise a Ring-billed Gull chick: first confirmed record of successful waterbird adoption across taxonomic families**

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This paper describes the natural adoption of Ring-billed Gull chicks *Larus delawarensis* by a pair of Caspian Terns *Hydroprogne caspia* at Gull Island, Presqu'île Provincial Park, ON. Behavior, provisioning rate, and growth of chicks were recorded to document this adoption. Naturally occurring, interspecific adoptions among waterbirds are rare and those between distantly related species have not been confirmed to produce fledglings. This observation of a Ring-billed Gull chick being raised by Caspian Terns beyond fledging (approximately 46 days of age) appears to be the first record of successful adoption across different taxonomic families of waterbirds. During linear growth, masses of adopted chicks were close to, or even exceeding, maximum mass of Ring-billed Gull chicks raised by gull parents. After 27 June, however, the adoptive tern parents reduced provisioning rates below those exhibited by conspecifics and the adopted gull chicks lost mass. One of the chicks left the territory and died. Although initial circumstances leading to the adoption were unclear, ultimately one gull chick was successfully fledged by the Caspian Terns which is remarkable given the different provisioning methods and diets of these species.

### **Prioritization of nesting site protection for Piping Plover *Charadrius melodus* in Massachusetts, USA**

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Begun in 1987, Mass Audubon's Coastal Waterbird Program annually monitors Piping Plover *Charadrius melodus* nesting activity and protects habitat at 160 beach sites comprising 115 km of Massachusetts' coastline. Nesting at these locations are approximately 250 pairs of plovers which constitute 14% of the Atlantic Coast population designated "threatened" under the US Endangered Species Act. Since listing, the abundance of nesting Piping Plover in the state has increased four-fold. However, fledging rates are below those estimated to sustain the population and have been declining since 1992. Productivity data from thirty-six sites (200 pairs; 72 km coast) monitored for 4–24 years were used to identify site management priorities. The ultimate objective is to develop a management framework to inform strategic protection of shorebird populations and habitat. Analysis of occupancy showed that 75% of sites have supported maximum numbers of plovers during the past five years; only five sites had maximum numbers earlier than 2000. This skewed distribution of sites showing current maximal levels of occupancy reflects both the growing number of birds using each site as well as the addition of new sites over time. Maximum fledgling production was observed during the early to mid-1990s, and again during 2007–2011 for more recently colonized sites. In contrast, most sites – especially those with

the longest history of use – recorded lowest fledging success during the period 2008–2011. Additional analysis of this recent period of poor reproductive performance is needed. Finally, a cumulative pair index and fledging index was developed to incorporate history and success of site use as well as site size to allow ranking throughout the region and to identify site attributes associated with occupancy and fledging success.

### **Flooded fields and wintering ducks: a comparison of hosting potential among European rice production areas**

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Rice fields provide foraging habitat to waterfowl, food availability being considered to depend on post-harvest practices. Winter flooding could be a major driver of regional duck abundance. To test this, we estimated flooded rice field area in Camargue (France) and compared the situation with the main rice production regions in Europe. We also considered the potential effect of natural wetland area. Estimations of flooded harvested rice area were based on satellite imagery analysis. For inter-regional comparisons, the following data were collected: (1) rice area, (2) percentage flooded in winter, (3) percentage of wetlands, (4) abundance of wintering ducks. On average 7.2–8.4% of the Camargue rice fields were flooded during winters 2000/01 and 2005/06. This value varied greatly among regions: the Elbre Delta and the Albufera de Valencia had the greatest values, ca. 90 and 62%, respectively. The figure was 20% along the Guadalquivir River. At the other extreme were the Camargue and the Po Valley (7 and 0.2%). The regions were ranked in a different order concerning the proportion of wetland areas, from best to least conserved: Camargue > Guadalquivir > Elbre > Extremadura > Albufera > Po. Wintering duck abundance was greater in regions with flooded vs non-flooded rice fields. Beside flooded rice areas, the proportion of wetlands also played a major role, as illustrated by large numbers of ducks in Camargue despite limited winter flooding. The inter-regional differences in rice fields management is mainly due to different financial incentives. Flooding harvested rice fields can improve habitat attractiveness to wintering ducks, though conserving natural wetlands can have a similar effect. In areas where the two habitats are present, introduction of rice field flooding may not lead to increased numbers of ducks in the short term, but may likely benefit the duck populations through the provision of nocturnal foraging grounds.

### **Successful attraction of Common Terns to a rehabilitated wetland on Lake Ontario**

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In Hamilton Harbour, Lake Ontario, the main, long-term nesting site for Common Terns *Sterna hirundo* has been Spur Island in Windermere Basin, a severely degraded wetland surrounded by industrial lands. In 2011, construction began on a project to restore wetland habitat at this site. Plans included resurfacing of Spur I. and creation of 3 new nesting islands for terns. To accommodate this work, terns were prevented from nesting at Spur I. in 2011 and 2012, and were instead translocated to alternate, temporary habitat 2.2 km away. Here we report on successful efforts to re-attract breeding terns to Windermere Basin in 2013, following completion of wetland rehabilitation. In early May, prior to nesting, 26 tern decoys and a continuous call-playback system were set up on each of the new islands; Spur I. served as a control. Three types of recordings were broadcast alternately on each of the islands over a period of 4 weeks: those from Hamilton Harbour (HH), other Great Lakes sites (GL) and the Atlantic coast of North America (AC). Counts of adult terns were collected daily from the adjacent mainland, at 10 minute intervals. Nests were counted, marked and their contents were recorded weekly. The number of nests increased to 151 initially, but nest predation by Ring-billed Gulls reduced the number to 65. After the removal of gull nests from the islands (under permit), the number of tern nests increased to a peak of 221 by 31 May. The number of nests initiated increased with the distance of the island from shore; Spur I., which was closest to shore and where decoys and playback were not used, consistently had the fewest nests. No difference was found between the L, GL, and EC playback conditions. Up to 40 terns were observed landing on one of the islands prior to equipment set-up, indicating that other factors, such as the configuration and substrate of the islands and their proximity to an existing nesting site, were also important in attracting them to the area.

### **Colony dynamics of Elegant Terns *Thalasseus elegans* in the Southern California Bight in relation to oceanographic conditions and disturbance events**

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Coastal seabirds are prey generalists known to be influenced by oceanographic conditions related to productivity and affected by various kinds of disturbance. The Elegant Tern, the most abundant seabird in southern California, nests at three locations, yet is recognized as a single population in the region. Numbers of nesting pairs provide the first measure of reproductive success, and they fluctuate dramatically for this tern within and among years at the three sites. Recently (2003–2012), nest numbers have ranged from <100–20,000 at the San Diego Salt Works, 300–10,000 at the Bolsa Chica Ecological Reserve, and 0–11,000 at Los Angeles Harbor. What are the forces driving these marked fluctuations? We know that conditions related to temperature and productivity vary within the region, and that disturbance events, which can cause colonies to abandon a site, also vary among the nesting locations. To address our question, we are first assessing oceanographic conditions in the region for 2003–2012 using chlorophyll a and sea surface temperature (SST) data collected by the Moderate Resolution Imaging Spectroradiometer (MODIS), a remote sensing instrument aboard the Aqua satellite. To account for lag effects between oceanographic changes and effects on Elegant Tern nest numbers, we are using average chlorophyll a and SST across a five-month period before the start of the breeding season each year (May).

Secondly, we are developing an index to quantify the impacts of disturbance, either from human or predator activity. Using a multiple regression analysis, we are testing the effects of chlorophyll a, SST, and disturbance on nest numbers. We expect Elegant Terns to be attracted to high chlorophyll and low SST, conditions that increase prey availability. We also expect that disturbance can cause this tern to abandon a site during a given season. Our study should help tease apart the factors driving these striking fluctuations in nest numbers.

### Are Salinas a good breeding habitat for Kentish plover *Charadrius alexandrinus*?

**Afonso Rocha**

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Many shorebirds are now breeding in artificial habitats such as Salinas, because their natural habitats have decreased dramatically in recent years. However, such artificial habitats may be an ecological trap due to high levels of nest predation. We studied the nesting biology of Kentish Plover *Charadrius alexandrinus* in Samouco salinas, the most important breeding area for this species in the Tagus estuary (Portugal), and evaluated the role of predation for the nesting success of this species. Nesting success was calculated using the Mayfield method for the periods 2005–2012. Despite strong variations in vegetation cover among years nest success was always low and similar among years. In the breeding season of 2012 we described and compared nest-site characteristics with those of random points and conducted an experiment with artificial nests. Habitat characteristics such as vegetation cover, proximity to water and nest exposition were important to explain nest-site selection but did not contribute to explain nesting success. Predation, particularly by crows, was the most important variable in explaining the high failure rates of both natural and artificial nests. Our data suggests that the management of predation levels is a key factor for the conservation of Kentish Plover breeding in salinas.

### Managing salinas as fuelling fuel stations for migratory waders

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To forage in salinas waders must have access to the substrate where invertebrates live, but they are able to quickly deplete food resources in confined areas, such as salt-ponds. A pond (9.31 ha) with high water level (>20 cm) during the winter/summer was drained in September to attract migratory birds. The number of foraging shorebirds of each species was counted daily until birds no longer used the area. Six enclosures of 1,5x1,5 m were established to prevent birds from feeding, and sediment cores were taken to assess invertebrate abundance inside and outside the enclosures in order to evaluate the rate of invertebrate depletion by the birds. Individuals of each species were filmed daily for one minute to determine time-budgets. After drainage, waders foraged in the pond in great numbers during both high and low tide. The sediment exposition contributed to a decrease in the abundance of macroinvertebrates in a 14-day period, but the birds' predation contributed for a

faster depletion. As the water level decreased, larger wader species were replaced by smaller species: Black-tailed Godwit's *Limosa limosa* and Black-winged Stilt's *Himantopus himantopus* foraged in the pond during the first six days, Redshank *Tringa totanus* used the pond during the first ten days, and small waders such as Dunlin *Calidris alpina* and Ringed plover *Charadrius haitcula* were abundant from day 2 to day 8. Probing predators such as Dunlins exhibited a higher feeding rate in the first eight days. Visual predators such as Ringed Plovers exhibited a high feeding rate from day 4 to day 7, with a high prey deglutition and a low number of steps. Our study shows that after drainage a salt-pond provides food resources for waders for about 15 days. Therefore, a system of salt-ponds that can be drained consecutively at specific time intervals will provide a continuous foraging area and may be very important for waders to accumulate energy reserves during migration.

### Assessing provisioning rates of Common Terns: traditional vs. automated methods

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Poor provisioning may indicate impaired environmental conditions or parental health. Understanding provisioning rates can identify the factors influencing breeding success, but comprehensive provisioning data across long time periods are difficult to collect. Time constraints and disturbance issues can prevent researchers from making observations during all daylight hours and lead to gaps in provisioning data collected by direct (in-person) watches. Automated recording using remote cameras may overcome these problems. We compared three watch methods to determine provisioning rates of Common Terns *Sterna hirundo* on Gull Island at Presqu'île Provincial Park, ON, Canada in 2012: (1) a time-lapse Olympus SP-565 UZ camera continuously triggered every 2s by a remote trigger (Pclix XT), (2) a motion sensitive Bushnell(R) Trophy Cam™ trail camera, and (3) direct watches from a temporary blind. All three watch methods simultaneously assessed provisioning rates at two nests for 2 h on each of 7 days in June. These 2-h watches were distributed throughout the daylight period. Pictures from camera methods were analyzed independently by two people, resolving any differences in the detection of feeds to chicks by consensus. Direct watches were significantly better at detecting feeds (mean±SD: 2.4±1.3 feeds h<sup>-1</sup>) than either time-lapse (1.5±1.2 feeds h<sup>-1</sup>) or motion-sensitive cameras (0.6±0.8 feeds h<sup>-1</sup>), although differences between the two camera methods were not quite statistically significant. We discuss several factors that may have prevented cameras from detecting all feeds, including vegetative cover at nests, behavior of tern chicks, and positioning of motion-sensitive cameras. Although automated methods failed to live up to their potential at Gull Island, they may offer powerful ways to collect provisioning data at most Common Tern breeding colonies where birds nest on sand, gravel, bare ground or in short vegetation.



## Is mercury pollution in Audouin's Gull a matter of concern?

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Because of its mediterranean distribution, breeding colonies of Audouin's Gulls are subject to the relatively high natural mercury levels of its waters. Moreover, the most important colony of this species, that in the Ebro Delta, is also exposed to the anthropogenic mercury wastes from the chlor-alkali industry operating upstream and carried down by the Ebro to the river mouth. To estimate the contribution of each of these mercury sources (natural vs. anthropogenic) to the observed gull's levels: i) we compared egg and feather mercury levels among Audouin's colonies subject to different mercury exposures ii) we studied the association between mercury levels and the foraging habitat of the species (from SIA analysis) and iii) we compared stable mercury isotopes between marine and freshwater habitats in the Ebro Delta. From different approaches we estimated the contribution from natural and anthropogenic sources to the final mercury concentration. We concluded that the Ebro Delta is a mercury hotspot and that Audouin's gulls breeding there are at risk from the toxicological point of view.

## Age-specific survival and recruitment of Piping Plovers *Charadrius melodus* in the Great Lakes region

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Juvenile survival and age at first breeding are critical parameters affecting population dynamics in birds, but high levels of natal dispersal preclude measurement of these variables in most species. We used multi-state capture-recapture models to measure age-specific survival and recruitment probabilities of Piping Plovers *Charadrius melodus* in the Great Lakes region during 1993–2012. This federally endangered population is thoroughly monitored, minimizing concerns that measures of survival and recruitment are confounded by temporary or permanent emigration. First-year survival ( $\pm$  SE) averaged  $0.284 \pm 0.019$  from mean banding age (9 days) and  $0.516 \pm 0.065$  from mean fledging age (23 days). Survival increased with earlier hatching dates, older age at banding, more fledglings at a given hatch site, and heavier mass at time of banding. Females had a higher probability ( $0.538 \pm 0.032$ ) of recruiting to breed at age 1 than did males ( $0.344 \pm 0.025$ ), but virtually all surviving plovers recruited into the breeding population by age three. Heavier chicks of both sexes were more likely to recruit during their first year than lighter individuals, but recruitment was not affected by hatching date or nesting population size. Adult survival was reduced by increased hurricane activity on the southeast

US Atlantic coast and by higher population indices of Merlins *Falco columbarius*. Annual adult survival averaged  $0.742 \pm 0.024$  for males and  $0.726 \pm 0.025$  for females (these estimates were not different); however, survival of both sexes declined through time. Early breeding and enhanced body condition led to improved juvenile survival and recruitment, so management actions focusing on protecting early nests and ensuring access to adequate feeding habitat may help increase recruitment in this federally endangered population.

## Change is the only constant: birds indicate long-term changes in the German Wadden Sea

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The international Wadden Sea is one of the largest wetlands in the world. Since 2009 most parts were added to the World Heritage List, one major reason being its main importance for birds. However, the Wadden Sea is also characterized by its highly dynamic nature, as it is an open system shaped by the North Sea and major river inflows. Although the Wadden Sea is protected for decades now, intensive human activities such as shipping, fisheries, mussel cultures etc. take place and influence the natural processes. Thus, all organisms have to struggle with strong day to day variability in abiotic conditions as well as with major changes over the years. Birds as top predators are particularly suited to illustrate these changes as they may indicate cascading effects in other trophic regimes as well as in abiotic conditions. In this talk we show how the species composition of birds in the Wadden Sea has changed over the decades. Possible reasons for declines in several species are presented. Two case studies on how two guilds of birds (i.e. omnivorous gulls and benthivorous sea ducks) were able to adapt to major changes in the food web of the Wadden Sea are shown. Twenty years ago Herring Gulls *Larus argentatus* and Common Eiders *Somateria mollissima* both fed to a very high degree on Blue Mussels *Mytilus edulis*. Blue mussels suffered a dramatic decline in many parts of the German Wadden Sea, recently. Nevertheless, numbers of both bird species were not significantly influenced by this decline. Recent data on habitat use (revealed by GPS-data logger and visual observations) clearly indicate that both bird species now feed intensively on Razor Clams *Ensis directus*, an invasive bivalve species which has immigrated with ballast water into the Wadden Sea several years ago. The strong link between birds and the invasive Razor Clam is an example which illustrates the resilience of the Wadden Sea against dynamic processes in the food web.

## Diurnal habitat use of the Sandhill Cranes *Grus canadensis* on spring staging in Nebraska, USA

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This study was carried out from the years 2003 to 2010 with the aims of determine habitat use and preliminary foraging ecology of the Sandhill crane during its spring stopover in the

River Platte, Nebraska, USA. Foraging ecology was obtained from data collected in 2010, counting the rates of pecking (probes/min) and progression (steps/min), in each habitat type. From the total of registered individuals, 72% occurred in cornfields. During the day Sandhill cranes spent most of the time foraging (45% or more) in all filed, except pasture where forage and rest are the main activities (>30% each). The rate of both foraging and progression were higher in cornfields (25/min). This study reaffirms the importance of filed corn as foraging sites for the Sandhill crane but also the relevance preserve pasture to improve diurnal rest sites. Also demonstrates the susceptibility of the crane to habitats dynamic present in the Valley, as already demonstrated elsewhere.

## Influenza Viruses in Gulls of Asia

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Influenza viruses are divided into subtypes based on the two surface glycoproteins, the HA and the NA. Seventeen HA and ten NA subtypes have been described, of which the HA16 and HA13 have been shown to be mostly gull-specific (order *Charadriiformes*). The Asian part of Russia, covering a large part of Northern Eurasia, is of special interest for Avian influenza virus (AIV) ecology and evolution. This area is crossed by three major migration routes – Central Asia, East Africa, West Asia and Black Sea/Mediterranean Flyway – combining bird populations from Asia, Africa and Europe. Especially many species of gull migrate or nest here. The importance of this region has been confirmed by the previous outbreaks of Highly Pathogenic Avian Influenza (HPAI) H5N1 among wild birds including gulls since 2005. We isolated H5N1 from clinically healthy Common Gull *Larus canus* in 2006. This possibly suggests that gulls can be a vector for AIV. Five years later we isolated a number of rare low pathogenic AIV H16N3 and H13N2 from this species. We isolated influenza A (H13N8) virus from the Mongolian Gull *Larus mongolicus* which was trapped at the Uvs Nuur Lake (Mongolia). It was the first isolation of this virus in Central Asia. Genetic analysis showed that this virus has gull-specific genes as well as genes from European classical Avian-like viruses (form duck viruses). Totally, the annual surveillance in Siberia and the Russian Far East showed AIV prevalence in Black-headed, Common, Mongolian, Caspian and Slaty-backed Gull species. From these species we isolated H5N1, H10N6, H13N2, H13N6 H13N8, H16N3 viruses. Thus, Larids of Asia are an important avian influenza virus reservoir for different AIVs. Our data highlights the relevance of the present study of gull-specific viruses in Asia and the need to search for viruses that may have pathogenic potential.

## Temporal and spatial aspects of aggressive interactions in nesting gulls

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I examined the factors that may influence the frequency of aggressive interactions in a colony of Herring and Great Black-

backed Gulls on Great Duck Island, ME (44°15'N 68°25'W). The type and intensity of aggressive interactions were recorded during 15-minute intervals regularly throughout the day, with particular emphasis on periods before and after colony-wide disturbances. Seasonally, aggressive interactions increased in frequency and intensity during the chick-hatching period and then decreased again as chicks neared fledging. Daily, these interactions increased following the start of a colony-wide disturbance, such as a close approach by a bird of prey, or the entrance of researchers into a specific colony area. Territory mapping and GIS analysis revealed that aggressive interactions increased primarily with nest density; the proximity of Herring Gull nests to Great Black-backed Gull nests was a secondary predictor of aggressive encounters. Vegetation and substrate types were also recorded, and analysis of these elements of local topography revealed that aggressive interactions were more frequent in territories with a greater range in elevation. Finally, I assessed the relationship between the frequency of these aggressive interactions and chick survivorship.

## Assessing the effects of pedestrians, vehicles, and aircraft on nesting American Oystercatchers on the Outer Banks of North Carolina

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We studied the effects of anthropogenic noise and human recreational activity on American Oystercatchers *Haematopus palliatus* nesting at Cape Lookout National Seashore in North Carolina by measuring how the birds' behavior, physiology, reproductive success, and survival varied with different types of human activity. We employed a variety of technologies, including audio recorders to monitor sound levels, video cameras and recorders to monitor oystercatcher behavior and human activity, and microphones embedded in artificial eggs to monitor the heart rates of incubating birds. We developed novel software to automate the analysis of both audio and video recordings. We quantified the behavioral responses of oystercatchers as the proportion of time spent on versus off their nests before and during human activity events, daily nest attendance, and the number of departures from their nests daily. We also compared the heart rates of incubating birds before and during human activity. Oystercatchers were equally likely to be observed on their nests before and during all types of aircraft overflights, but they were on their nests less often during all types of off-road vehicle and pedestrian events than before those events occurred. Overall, the response of incubating birds to flights through the airspace over Cape Lookout National Seashore was lower than their response to all other types of human activity. We found no association between the altitude of overflights and any behavioral response of incubating birds. However, we did find that the heart rate of incubating oystercatchers increased during low-altitude flights flown through the airspace. No other human activity affected the heart rate of incubating birds. The probability of oystercatchers leaving their nests when off-road vehicles or pedestrians passed by was higher for nests located in open sand habitats compared to nests in dune habitats.

## The effect of Intensified rice production on avian biodiversity within the Philippines

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The climatic and geographic range of Asia provides ideal conditions for growing rice. With a growing demand for food security to feed an ever increasing human population, there is growing pressure to increase rice production. Within the Philippines, rice fields cover over 2.6 million ha and provide habitat for at least 82 species of waterbirds. Thus, any changes in cropping intensity is highly likely to have a knock-on effect on regional wetland bird populations. Over a ten-month period, spot counts were conducted at four rice field sites in Isabela province, N. Luzon, Philippines, for four consecutive mornings per month. The order of the surveys was rotated daily to eliminate any time of day effect. Each count lasted 20 minutes and the total number of species and individual birds was recorded. Two sites were in newly intensified rice field areas growing five crops over two years, and two sites were in rice field areas growing the traditional four crops over two years. Each site was located a minimum distance of 1 km from any different field management system. Preliminary results indicate that the mean number of individuals was slightly higher in the intensified cropping system compared to the traditional system. Additionally, the intensified crops had a higher mean number of species recorded. One possible explanation for these findings is that the intensively managed rice crops provide habitat for a number of avian species, especially migratory species, during times when there is no rice planted in the traditional cropping systems. However, the shorter duration of the rice crops in the intensively managed areas may have an overall negative effect on some species, especially waterbirds, due to reduced periods of suitable habitat availability during breeding. Continued surveying over a longer period of time is needed to monitor for any such long-term effects.

## Fisheries and Scopoli's Shearwater interactions assessed through GPS tracking, Vessel Monitoring System positioning and stable isotope analyses

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Fisheries often target the same resources as seabirds and can ultimately deplete fish and seabird populations. Some fisheries, however, also provide discards and promote an increase of some seabird populations, but the imminent modification of the Common Fisheries Policy (CFP) will ban discards, which may readjust population numbers. Therefore, assessing the relationship between fisheries and seabirds is needed. We aim to assess the degree of interaction between fisheries and Scopoli's Shearwaters *Calonectris diomedea* in the Catalan Sea. We tracked 44 shearwaters with GPS devices during the chick-rearing period,

August and September 2012, breeding in Minorca to determine their foraging areas. We also collected concurrent data from the Vessel Monitoring System to quantify the spatial overlap and spatiotemporal interactions with tracked seabirds. We took blood samples from each bird at GPS recovery and analysed the stable isotope ratios of C and N to assess the relevance of discards for the diet of shearwaters. Overall we obtained 145 foraging trips. In August, Scopoli's Shearwaters mainly foraged on the Catalan shelf, whereas in September birds shifted to closer foraging areas on the Minorca Channel. This change was also accompanied by a shift in N and C stable isotopic ratios. We detected a substantial spatial overlap between seabirds and fisheries mostly concentrated on the continental shelf. However, stable isotope ratios indicate that discards were a relatively minor resource in the shearwater diet and spatiotemporal interactions were low, suggesting fishery activity has a limited influence on population level foraging strategies. Overall, our results suggest the Reform of the CFP will have a negligible effect on population dynamics of Scopoli's Shearwaters, but we note that overlap of shearwaters and some fisheries for the same target species in the same areas and periods may ultimately limit Scopoli's Shearwater populations.

## An unusually large number of Common Terns nesting on a rooftop in Ontario

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Increases in the human population have led to development of previously natural areas and subsequent loss of colonial-nesting waterbird habitat. A number of gull and tern species have adapted to urban environments by nesting on rooftops and other human-made structures. Previous reports of Common Terns *Sterna hirundo* breeding on rooftops have involved small numbers of nests (n=1, McFarlane 1977; n=4, Cameron 2008). Here, we report an occurrence of an unusually large number of Common Terns nesting on a marina rooftop in Port Credit, Ontario. Situated on the northwestern shoreline of Lake Ontario, approximately 15 km southwest of downtown Toronto, the marina was visited in response to bird nuisance and damage complaints by the facility manager. A complete survey of the rooftop was conducted on May 31, 2013, when 1,011 Common Tern nests were counted. Clutch sizes ranged from 0–5 eggs (0e=26%, 1e= 12%, 2e=17%, 3e=39%, 4e=2%, 5e<1%); an additional 2% of nests were predated or added. Two percent of nests contained at least one chick (some also had hatching eggs), all aged less than 4 days. The flat rooftop measuring 341 m x 46 m was covered with fine pea gravel (6 mm diameter) and contained sparse vegetation distributed across the rooftop. Common Terns have been observed nesting at this site ( $\leq 50$  pairs/yr) since 2009, however, the reasons for the sudden and large increase in numbers during 2013 are unclear. Inclusion of inland sites, particularly suitable roofing structures, should be considered for future Common Tern surveys in this region. The results of a follow up visit to assess breeding success will be presented, and plans to translocate this colony to a nearby breakwater in 2014 will be discussed.

## Exploratory behavior and independent foraging appear to have begun earlier in slow growing, starving chicks of black-headed gulls

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In Black-headed Gulls *Larus ridibundus* L. parents are responsible for food provisioning of offspring until they are 30–35 days of age and even more. However, some chicks develop independent food provisioning strategies, foraging on invertebrates and stealing food from neighboring broods as early as 1–2 weeks of age. In crowded colonies early chick exploratory behaviour is risky because of social conflicts with neighbours. We investigated psycho-physiological traits in self-provisioning chicks in comparison with those provisioned fully by parents. We monitored development of behavior in 27 chicks from nine 3-chick broods in their natural environment, from 7–15 days of age. All 15 day-olds were tested in the “open field”. We estimated latent period as reflection of fear and total distance passed as manifestation of a level of exploratory activity. In nature we recorded all trips of the chicks, their visits to nests of neighbors, cases of stealing food and pecking invertebrates in the grass. For 15 days after hatching, parameters of growing were measured including head-bill length and tarsus. Chicks provisioned fully by parents and not obtaining food by themselves between 7–15 days old appeared to grow faster since the moment of hatching than chicks that used supplementary food provisional strategies such as kleptoparasitism and foraging on invertebrates. The latter individuals began exploring the open field earlier and more actively. It is likely that in Black-headed Gulls high mobility and frequent visits to neighboring nests in young chicks correlate with high level of exploratory activity and low level of neophobia. Judging by slow growing, these “exploratory” chicks suffer from a low rate of parent provisioning since hatching. We speculate that the risk of death by starvation exceeds costs of territorial conflicts and therefore “exploratory” chicks develop early experience and reach an optimal foraging strategy.

## Metal contaminants in shorebirds during migration through Delaware Bay

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Shorebird migration through Delaware Bay represents the largest concentration of shorebirds on the east coast and coincides with the spawning of horseshoe crabs, whose eggs make up the bulk of the shorebird diet. In the past two decades, shorebirds using Delaware Bay have experienced population declines coinciding with decreased availability of horseshoe crab eggs. While lack of sufficient food supply in the bay may be a driving force in these declines, other constraints on shorebird populations including anthropogenic factors such as exposure to contaminants need to be taken into consideration. In 2011 and 2012 we examined levels of heavy metals, cadmium, chromium,

lead, and mercury, and arsenic in feathers of three shorebird species, Red Knot *Calidris canutus*, Sanderling *Calidris alba* and Semipalmated Sandpiper *Calidris pusilla* to compare to those reported in a previous study conducted 20 years ago. Preliminary data show decreasing levels of lead in all three species since the 1990s, and decreasing levels of Cadmium and Chromium in Red Knots and Semipalmated Sandpipers. However, mercury levels were lower in our samples compared to those of the 1990s only in feathers of Sanderling. In addition, we explored levels of contaminants in blood samples collected from these birds at different times during migration. Levels of metals in blood change during their stopover, however temporal patterns differ among species and metals probably as a reflection of diet and molting patterns.

## GPS tracking reveals individual specialization of fisheries discard use by Lesser Black-backed Gulls *Larus fuscus* in the western Wadden Sea

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The proposed ban on fishery discards within the European Union is likely to profoundly impact seabird populations. While seabird-fishery associations are well documented, this research primarily comes from ship-based surveys and consequently, individual level responses to discard availability are largely unknown. Using GPS tracking data from 46 Lesser Black-backed Gulls *Larus fuscus* breeding on the island Texel, the Netherlands, we investigated the relationship between foraging movements and fishery activity. Within the Wadden Sea, shrimp fisheries are only active during weekdays, which offers a natural experiment to examine how seabirds may adapt to the loss of discard resources. Using habitat selection analysis between weekdays and weekends, we examined how individuals adjusted their activities based on fishing activity. The spatial and temporal dynamics of Wadden Sea use varied substantially between weekdays and weekends. At the population level, significantly more time was spent in the Wadden Sea on weekdays, with activity concentrated in deeper bathymetric zones where fishing vessels operate. Seven females, were largely responsible for this pattern. These individuals made higher use of the Wadden Sea both during and after the breeding period, indicating that these individuals specialized in discard scavenging. There were no significant differences in biometrics between the scavenging specialist females and other females, which suggests that discard use is not motivated by an overtly physical advantage. With the loss of discards on weekends, scavenging specialists primarily responded by switching to foraging on terrestrial habitats. Additional aspects of time budgets, such as nest attendance and total foraging time, were consistent between weekdays and weekends, which suggests that a resource shift on weekends did not impact daily time budgets. As such, it appears that scavenging specialists are able to flexibly respond to the loss of discard resources.



## Black Tern pairbond and breeding site fidelity in The Netherlands

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Within the family *Sternidae*, the social behaviour of the genus *Chlidonias* is relatively poorly studied compared to the genus *Sterna*. Although widespread over Europe, the breeding habitat of *Chlidonias* terns, in less accessible marshlands, makes studies difficult. Species of the genus *Sterna* but also of the genus *Gelochelidon* and *Hydroprogne* are monogamous with a high year-to-year pair bond fidelity, e.g. with an estimated 75% inter season pair bond fidelity in Common Tern *Sterna hirundo*. Several *Sterna* species also show a relatively high site fidelity. In order to get more information on pair bond and site fidelity in *Chlidonias* terns, a colour-ring study had been started in 2002 with 30 individually ringed birds until 2012 in a colony of 20 to 25 pairs. The colony is situated close to a touristic area and birds are used to human presence and therefore it is possible to check colour rings from a close distance. Birds are regarded as divorced if both are present in the next year but without a pair bond. The data suggest that Black Terns have no year-to-year pair bond and also divorces within a season after nest losses are usual. Forty-seven percent of the Black Terns returned to the same colony at least one year but movements to another colony are also recorded yearly. Thus, in terms of social behaviour Black Terns are quite different from *Sterna* terns. This might be related to the low habitat and nest site predictability. Locations of marsh with suitable nest substrates are on average less predictable than *Sterna* habitat on islands. So time to wait and search for the partner of the previous year might be less rewarding. In this respect it will be interesting to study the selection processes in partner choice in this species compared to others in the *Sternidae* family.

## Evaluating accuracy and utility of a field tool for estimating ages of Common Tern chicks

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Assessing productivity at waterbird breeding colonies provides information about the viability of individual sites and contributes to conservation decisions. For species such as the Common Tern *Sterna hirundo* that have age-dependent chick survival, determining productivity requires accurate estimation of chick ages. This is difficult when sites are only visited once or twice during the breeding season. We describe and test a comprehensive field guide that provides a simple, yet accurate, way for personnel of varying experience to estimate the age of Common Tern chicks. We took standardized photographs and measured biometrics of Common Tern chicks at Presqu'île Provincial Park, Ontario, Canada. Morphometric data (mass, wing length, body length, head and bill length, and egg tooth presence) of known-age Common Tern chicks were collected in the field from 2008 to 2013. Photographs were analyzed for physical characteristics diagnostic of specific ages. The resulting single-page field guide uses illustrative photographs (including wing development) from six age groupings that encompass distinct developmental stages of Common Terns. Morphometric

data are summarized statistically to illustrate the range of measurements for each group. Experimental field tests were used to determine the guide's capacity to improve accuracy of chick aging by experienced and inexperienced observers. Field tests were conducted in several breeding colonies located in the upper and lower Great Lakes, on the Saint Lawrence River, along the east coast of America, and in Germany in summer 2013. Preliminary tests of the field guide in the field and lab show that it provides a powerful tool for both experienced and untrained personnel to accurately estimate age of Common Tern chicks and 2013 data are expected to strengthen these conclusions and illustrate its broad applicability.

## Dietary and stable isotope analyses reveal the role of a cryptic prey in the Elegant Tern *Thalasseus elegans* food web in southern California waters

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Species composition of dropped fish collected at Elegant Tern *Thalasseus elegans*, ELTE, colonies in southern California shifted from mainly northern anchovy *Engraulis mordax* in the 1990s to >60% kelp pipefish *Syngnathus californiensis* in 2011. This change was unexpected as ELTE is an open-water forager, and the pipefish is cryptic in kelp. In response, we tested the following hypothesis at the Los Angeles Harbor nesting colony in 2012: Kelp pipefish are incorporated into the ELTE diet based on dietary analyses-direct observations of prey transfer, regurgitated prey, and dropped prey-, and a  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  isotope mixing model. Direct observations revealed that the ELTE chick diet comprised 8% kelp pipefish, while dropped fish comprised 47% pipefish. Regurgitations included no pipefish, but were collected on only one day. A stable isotope mixing model in R (SIAR) estimated 51% (95% CI: 36% - 66%) pipefish in chick blood tissue, 38% (95% CI: 0.03 - 0.72%) in adult blood tissue, and 32% (95% CI: 0.01-0.59%) in chick muscle tissue. The similarity of prey-northern anchovy, kelp pipefish, market squid *Loligo opalescens*, and California grunion *Leuresthes tenuis*-isotope values, however, hinders using mixing models to determine relative contributions of prey species to the ELTE diet, which could explain the large credibility intervals we observed. The prey deliveries and the mixing model support our hypothesis that pipefish are incorporated into the ELTE diet, although the proportions vary. A speculated increase in pipefish abundance in southern California waters is likely associated with increased kelp density over the past decade. Abundant pipefish available may explain the growing importance of pipefish in the ELTE diet as ELTE is an opportunistic forager. As a shallow plunge diver, ELTE likely capture pipefish when this fish leaves the safety of kelp cover and approaches the surface to feed or mate.

## Identifying important foraging areas for breeding terns (*Sterna* spp.) in the UK

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The four species of larger terns (*Sterna* spp.) that breed in the UK (Arctic, Common, Sandwich and Roseate Terns) are listed

as rare or vulnerable under Annex 1 of the EU Birds Directive. Although protected at their colonies through a network of 32 Special Protection Areas (SPAs), there are currently no marine SPAs designated for their feeding areas. Adequate protection of key foraging areas requires detailed knowledge of their foraging preferences and an understanding of how these animals are using the marine environment. Our study applies a habitat modelling approach to identify important foraging areas. Using the novel 'visual tracking' technique, three seasons (2009-2011) of targeted data collection at selected colonies provided foraging location data from a total of 1,157 tracks (Arctic n=184, Common n=405, Sandwich n=515, Roseate n=53) from 18 colonies (Arctic n=4, Common n=7, Sandwich n=6, Roseate n=1). These data were modelled with respect to a series of environmental variables related to prey availability and distribution using the statistical regression technique of Generalised Linear Modelling (GLM). Preliminary results show a close match between the relative distributions of predicted usage and the underlying data, and we present the example of predicted species-specific usage of waters around Coquet Island, Northumberland. The next steps involve the geographical extrapolation of models to data-poor colonies, and the application of the maximum curvature technique to delineate the most important areas of use that should be included within a possible SPA boundary. This involves the modelling of the relationship between cumulative usage against cumulative area to identify the point at which usage is so low that disproportionately large areas would be required to include them within a boundary.

### Advancing US Great Lakes colonial waterbird monitoring priorities through sampling and collaboration

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Several million colonial waterbirds nest in the Great Lakes annually. Since the 1970s, monitoring to assess their status has included a complete decadal count of all nesting pairs at all sites. However, this approach is expensive, labor intensive and slow to produce data to detect population change. In US waters, an effort was recently developed to estimate trends for eight regularly occurring species using more frequent monitoring at 72 focal locations, or only 9% of the total known colonial waterbird sites. These sites were occupied by the majority (63–100%) of pairs of each of eight regularly breeding species present, and comparison of growth rates as estimated from the four Great Lakes surveys at the focal sites vs. all Great Lakes sites indicated that trends detected by both approaches were similar for all species with few exceptions. In 2012, the sampling approach was launched, relying on a core group of 30 cooperators representing 24 agencies and institutions who made a commitment to regularly monitor these focal sites. Estimates for most sites (96%) were obtained in this year; estimates for the remaining 4% of sites were obtained in 2011. Results indicated that three species (American White Pelican, Great Egret, and Caspian Tern) had increased since the last decadal survey (2007–2009), while five had declined (Double-crested Cormorant, Great Blue Heron, Black-crowned Night-Heron, Herring Gull and Ring-billed Gull). Additionally, important observations at several sites (e.g. abandonments or large increases) highlighted the need for more frequent and focal monitoring in regional areas, and the need to incorporate adaptive efforts as necessary to identify and track important

population changes. Because this effort cost approximately one-tenth that of the decadal effort and revealed important population-level information for U.S. Great Lakes colonial waterbirds, we recommend this approach be adopted and that the next survey take place in 2015.

### Black Tern Habitat in the North American Great Lakes Region: a Model Validation Study

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Despite maintaining a broad geographic distribution across North America, the Black Tern *Chlidonias niger surinamensis* has experienced significant declines in abundance over the past half century, especially in the North American Great Lakes region. The number of Black Tern breeding colony sites in this region has also decreased substantially, suggesting that limited availability of suitable breeding habitat could be contributing to the observed population decline. We tested the validity of a landscape suitability index (LSI) for Black Terns developed by the Upper Mississippi River & Great Lakes Region Joint Venture as a tool for regional conservation planning. The LSI ranks wetlands based on amount of open water and emergent wetland habitat. Sixty wetlands, comprising a stratified random sample, were surveyed for breeding Black Terns and the correlation between LSI score and Black Tern abundance was examined. Twenty known Black Tern breeding sites within the region were also surveyed for habitat comparisons. Breeding Black Terns were rare at random survey sites, even those with high LSI scores. Results from both random survey sites and known breeding sites emphasized the importance of wetland complexes, defined as habitat patches containing both emergent wetland and open water. Refinements to the existing LSI, including stronger weighting of wetland complexes over other habitats and incorporation of additional remotely-sensed landscape variables, will be tested in the future. A more accurate LSI will improve the efficiency of selecting sites for conservation and restoration efforts for Black Terns in the Great Lakes region.

### The influence of weather conditions on the breeding performance of Common Gull in the south of Western Siberia

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Long-term population studies of Common Gull *Larus canus* were carried out on the islands of Lake Chany (area 2,000 km<sup>2</sup>) in the south of Western Siberia. The studies began in 1993, the number of nesting pairs on the lake since that time ranged from 1,600 to 3,300 and in the particular colony studied varied from 350 to 1,400. The relationship was studied between the timing of breeding, clutch size, egg size and breeding success with environmental factors. The appearance of the first egg in the colony was positively correlated to the date when the average daily temperature reached 0°, and negatively with the force of

the wind and the number of days with precipitation during the second ten days of April. Average date of egg laying (date when egg laying starts in 50% of nests) varied from 2 to 21 May and was positively correlated with minimum air temperature over the last ten days of April. The annual average clutch size was weakly correlated with the mean daily minimum air temperature. The egg size was most associated with weather conditions for clutches initiated in the first ten days of May, when most of the birds started to reproduce. A significant negative correlation was observed between egg volume and the number of days per month with wind gusts of 15 km/h. Hatching success ranged from 33% to 84%. A significant reduction in breeding success over the past 10 years was noted. There was evidence of a significant correlation between the proportion of destroyed eggs in colony and the force of the wind within thirty days from the date of first laid eggs. The combination of strong winds and rain led to maximum destruction of nests. The effect of wind was partly due to the deteriorating conditions of obtaining the main food (fish) for Caspian Gull *Larus cachinans* and their switch to preying on Common Gull nests. Also during these conditions a significant increase in the destruction of Common Gull nests by Hooded Crows and Rooks was noted.

### **Movements and at-sea activity of Boyd's Shearwaters *Puffinus boydi* using geolocators and stable isotopes analyses**

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While many tracking studies have been conducted on large pelagic seabirds, few studies have been realized on smaller seabirds, especially those breeding within tropic and subtropic regions. For example, little is known about distribution and movements of Boyd's Shearwater *Puffinus boydi*, a Procellariiform endemic to Cape Verde Islands. We used geolocation-immersion loggers to track 28 birds from two breeding sites (Raso and Ilheu de Cima) from 2007 to 2012. We also analyzed the stable isotopes of carbon and nitrogen in the 1st primary, 1st and 8th secondary and 6th rectrice feathers of tracked birds. Analyzing the salt-water immersion data we characterized the at-sea activity of Boyd's shearwaters. After breeding, one individual was resident to the Cape Verde waters over the entire non-breeding period, while the remaining birds migrated on average 1448 km (range 923–2,442 km) to the central Atlantic Ocean (5–15° N/ 30–40° W), where they stayed on average 119.9 days (SD = 61.7). The prenuptial migration of Boyd's Shearwaters started between August and October and birds needed on average 6.3 days (SD = 4.2) to arrive at the breeding area. In pre-laying period shearwaters dispersed mostly in the north area of Cape Verde Islands. Incubation started between January and February. Changes in stable isotope signatures suggest that animals moult their 1st primary and both 1st and 8th secondary feathers in different areas. During the nonbreeding period birds spent a greater proportion of the time resting on the water than during breeding. Combining three different approaches we were able to describe changes in the distribution and activity pattern of small pelagic seabirds during their annual life cycle.

### **Dynamic feeding strategies of Cory's Shearwaters over the breeding season as revealed by GPS and stable isotope analyses**

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Assessing how the trophic ecology and foraging strategies of top predators change over time is essential to understand the dynamics of the ecological relationships among marine organisms. The Canary Current is one of the major upwelling areas of the Atlantic Ocean, supporting a complex seabird community, yet how seabirds exploit it remains little studied. We aim to understand the use of the Canary Current by the Cory's Shearwater *Calonectris borealis*, one of its most common seabirds breeding on the nearby Canary Islands. We tracked shearwaters with GPS and analyzed the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  stable isotopes in their blood as well as in prey collected from the two major feeding grounds, the Canary Current and Gran Canaria waters, to reconstruct the adult and chick diets. Isotopic signatures of prey from the two areas were clearly segregated in typically offshore (Gran Canaria) and inshore productive (African shelf) signatures. Adult diet reconstruction suggested cephalopods and crustaceans as major food resources during the chick rearing period, thus matching with an increase in nocturnal activity during long trips in African shelf. GPS trips and diet reconstruction generally agreed in the differential use of Gran Canaria waters and the Canary Current over the breeding season. In the chick rearing period, shearwaters showed the typical dual foraging strategy, alternating short and long foraging trips. Stable isotope analyses confirmed that short trips were generally performed to feed the chicks whereas long trips were mainly used for self-maintenance. Our results show how GPS tracking and stable isotope analyses complement each other and help reveal the meaning of changes in seabird feeding strategies over the breeding season.

### **Fitness prospects: effects of gender, recruitment age and senescence on reproductive value in a long-lived seabird**

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Reproductive value is an integrated measure of survival and reproduction fundamental to understanding life-history evolution and population dynamics. By applying mixed models to longitudinal individual-based data of the Common Tern *Sterna hirundo*, we estimated age-specific survival probability, breeding probability and reproductive performance, based on which we calculated age-specific reproductive values. We investigated effects of sex, recruitment age and senescence, and found a small effect of sex on survival probability, strong senescence in breeding probability, and decreasing age-specific breeding success with recruitment age. As a result, males had lower fitness prospects than females, while birds of both sexes that recruited at the age of three (i.e. half of the tern population)

achieved the highest fitness. Fitness costs of senescence were found to exceed those of other bird species. Our study obtained the reproductive value for each recruitment age and demonstrated the importance of analyzing a representative measurement of fitness in the areas of senescence and population dynamics.

### **Factors affecting nest success of Wilson's Plover in South Carolina**

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Wilson's Plovers *Charadrius wilsonia* are beach-nesting birds that often nest with or adjacent to other waterbirds in the southeastern USA. Threats to beach-nesting birds in this region include anthropogenic habitat modification and disturbance, sea-level rise, and predation from native and non-native species. Little is known about the reproductive ecology of Wilson's

Plover in the southeastern USA. In an attempt to address gaps in the literature, we studied nest success at two field sites in South Carolina. During the 2012 breeding season we monitored 39 nests over 103 days. A total of 17 nests hatched and 22 nests failed. The primary causes of failure were flooding and predation. Nest success appeared to be affected by location which left low lying nests at risk of flooding. The average initiation date was 29 April 2012, the average hatch date was 18 May 2012, and the average failure date was 16 May 2012. The daily survival rate (DSR) of nests at South Island was 0.9748 and at Sand Island was 0.9652. The probability of success over a 25-day incubation period at South Island was 0.5423 and at Sand Island was 0.4272. Habitat data were taken at each nest site including, distance to landmarks, ground cover at the nest site, and presence of predator sign within 2 m of the nest. These measures were repeated at an unused nest site 5m away. On average, nests were 38.07 m away from the tide line and 14.74 m away from the dune. Unused sites were an average of 30.80 m from the tide line and 662.92 m away from the dune base. Similar data are being collected during the 2013 breeding season and we also will be radio-tracking parents to assess habitat use.





# International Wader Study Group Conference

## Abstracts of Talks

### Wadden Sea Studies

#### Migratory birds in the Wadden Sea – huge numbers, contrasting trends and still no clue?

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The International Wadden Sea, which includes Dutch, German and Danish coasts, is the one central staging and resting site for some 10–12 million waterbirds, of which some 3.5 million are waders, on the East Atlantic Flyway between the Arctic and Africa. Here, counting and monitoring waterbirds has a long history, and results go back to the late 1980s. They include 33 waterbird species, of those 19 waders, and provide 22 years and ten years of trends, phenologies and distributions. In the light of decreasing trends for some species plus the fact that those trends differ in different regions of the Wadden Sea, available data have been analysed to unravel some of the reasons behind those developments. While no single reason / parameter for these regionally differing trends could be detected, some indication pointed to a combination of factors within the Wadden Sea, for example food quality and availability, as well as changes in the intertidal area. The combined trends of species belonging to ecological guilds based on feeding habitat, food, breeding or wintering areas will be presented. Future efforts and potential improvements of analysis will be discussed.

#### Migration strategies of satellite tracked Grey Plovers *Pluvialis squatarola* staging in the Wadden Sea

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The Wadden Sea is the most important stopover and staging site for millions of Arctic waders using the East Atlantic Flyway, but their detailed destinations and migration routes are little known. The Grey Plover is a typical example: It is a

long distance migrant and over 50% of the flyway population uses the Wadden Sea during migration. To analyze migration routes and connectivity between breeding grounds, stopover sites, and wintering areas, we marked 14 Grey Plovers with 5 g satellite transmitters and 24 birds breeding on Kolguev Island/Barents Sea with 1.5 g light-level geolocators in 2011/12. Breeding sites of Grey Plovers staging in the Lower Saxon Wadden Sea are located on Yamal and Taimyr, wintering areas ranged from Northern Ireland to Guinea Bissau. Grey Plovers made annual flights of up to 20,000 km. Maximum non-stop flight distance was 3,400 km. Birds did not minimize migration distance. They flew neither on the great circle route nor primarily along the coast between the Wadden Sea and their Arctic breeding grounds. Contrary to existing presumptions, 75% of the tracked birds during spring migration used a route crossing the interior of Northern Russia, making a mean detour of 600 km. Except that all birds left the Wadden Sea in spring within only 4–6 days, there were marked differences between spring and autumn migration. Including stopover times, Grey Plovers traveled 2.5 times faster on spring than autumn migration. During spring migration, birds used 1.8 resting days per 1,000 km on average and 5.5 days during autumn. Moreover, mean ground speed was 9.3 km/h higher during spring than autumn. The highest mortality occurred during the migration periods. The project was funded by the Federal Agency for Nature Conservation under the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the Niedersächsische Wattenmeerstiftung, and the Committee for Bird Protection.

#### Oystercatchers moving with the tides: site-fidelity in a dynamic environment

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Knowing the spatio-temporal distribution of foraging shorebirds is of basic relevance to policy and management of intertidal areas. But which of the multitude of factors that have been shown to affect shorebird foraging are most relevant for explaining spatial distributions? Generalized functional response models may be considered the standard null model of

shorebird distribution. They have been used to predict the spatial distribution of birds given their distribution of food, under the assumptions that birds attempt to maximize intake rate as a short-term fitness objective and behave as ideal and free predators. Remarkably few quantitative assessments of the degree of applicability of these models to free-living shorebirds exist for real intertidal systems. An important aspect preventing quantitative comparisons with model predictions has been the lack of observational data that covers the typically extensive foraging home ranges, as well as the relevant temporal cycles (tidal, diurnal, seasonal) that affect spatial distribution and food availability. We used GPS-tracking of individual free-living oystercatchers to quantify how oystercatchers distribute themselves in relation to the tidal cycle and their food. High-resolution benthic surveys were carried out in the core foraging areas of focal individuals. The study permits a comparison of observed and predicted spatial distribution and food depletion, and identifies key factors governing the spatio-temporal distributions (focussing on association with intake rate, interference effects, and tide line effects). We argue that the benefits associated with high site fidelity, as observed in the Eurasian Oystercatcher, may lead to a weaker association with patch quality than predicted by ideal free models.

### Conservation ecology of a declining long-distance migrant shorebird in a UNESCO world heritage site

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Migratory shorebirds and their intertidal habitats are under enormous pressure from global change processes. Developing strong conservation and management tools requires detailed knowledge on an animal's habitat requirements. The Schleswig-Holstein Wadden Sea, Germany, is a key fuelling site for Red Knots during northward migration. Fuelling conditions during that time of year determine both current survival and that year's reproductive success. We studied the fuelling ecology of individually colour-ringed Afro-Siberian Red Knots, one of two in-the-field indistinguishable red knot subspecies using the area during April and May. We discovered that prey distribution limits foraging habitat for Afro-Siberian Red Knots to a relatively small area, entirely non-overlapping with the foraging area used by the other, Nearctic subspecies. This finding has

important consequences for potential future conservation issues: although the Wadden Sea is protected both as national park and UNESCO world heritage site, the very area used by Afro-Siberian Red Knots is located in the vicinity of an oil platform. If the area is affected by oil exploitation activities, not only half of the red knot habitat would be threatened, but so would the sole fuelling site of an entire subspecies, potentially leading to their extinction.

### Reduced apparent survival contributes to the decline in the use of the East-Atlantic flyway by Ruffs *Philomachus pugnax*

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Ruffs (*Philomachus pugnax*) are long-distance migrant shorebirds using the Palearctic-African flyways. Their decline along the East-Atlantic route since the 1970s has been associated with the loss of wet grasslands on the Dutch staging area, and drought and human-induced changes in the Sahel. In contrast, Ruffs sharing the Sahel wintering grounds but migrating via more easterly routes show increasing numbers. Based on capture-mark-resighting data collected in The Netherlands during 8 northward migration periods (2004–2011) we used a multiple inference approach to investigate relationships between apparent annual survival and local and global environmental factors as a function of sex and age. To overcome biases in survival estimates due to hidden heterogeneity in detection probabilities, we used a Capture-Mark-Recapture multi-event framework to assign birds to distinctive classes of either high or low detection. Highly detectable (HD) males survived better than males with low detectability (LD). In contrast, highly detectable females survived worst. For all combinations, annual survival probability varied in parallel and showed a severe decrease (>40%) over the study period. Survival was not associated with flood extent in the Sahel, spring weather in The Netherlands, or with broad-scale climate patterns during staging, breeding and wintering. The common pattern in survival trajectories supports a high mortality in and/or permanent emigration from the East-Atlantic Flyway. We discuss this and potential origins of the hidden heterogeneity in individuals' detection rates in light of the puzzling sex differences.



## Wader Studies around the World

### Monitoring of shorebirds along the coast of Abu Dhabi in the United Arab Emirates

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With more than 450 species of birds recorded, UAE is an important area for birds, particularly migratory waterbirds, which constitute nearly 30% of all the bird species recorded. Monthly counts for shorebirds were undertaken at 14 sites in the Emirate from 2006 to 2012 and a total of 135 surveys were conducted during this period. The number of species varied significantly across the sites ( $F = 81.05$ ,  $df = 13$ ,  $p = 0.00$ , One-way ANOVA). The number of species was higher in winter ( $21.36 \pm 0.31$ ) than in summer season ( $20.78 \pm 0.39$ ), but the difference was not statistically significant ( $F = 1.30$ ,  $df = 1$ ,  $p = 0.25$ ). The number of species varied significantly across the years ( $F = 5.36$ ,  $df = 6$ ,  $p = 0.00$ ). The number of birds also varied significantly across the sites ( $F = 56.61$ ,  $df = 13$ ,  $p = 0.00$ , One-way ANOVA) and numbers were higher in winter ( $4496.41 \pm 306.54$ ) than in summer ( $1834.40 \pm 199.43$ ) and the difference was highly significant ( $F = 53.41$ ,  $df = 1$ ,  $p = 0.00$ , One-way ANOVA). The number of birds varied significantly over the years ( $F = 2.54$ ,  $df = 6$ ,  $p = 0.02$  One-way ANOVA) and showed a negative trend. Most of the sites are under threat due to development and have undergone rapid changes and our results show a declining trend, similar to shorebird declines globally. Conservation of key coastal sites remains a top priority for shorebird conservation in Abu Dhabi and we discuss our results in the light of importance of key sites for conservation of shorebirds in Abu Dhabi.

### Post-breeding wader stopovers on the central part of western coast of Kamchatka, Russia

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The data were collected in 2010–2012 in the estuaries of three rivers: the Belogolovaya-Khairusovo estuary (57°N, 156.7°E) and Moroshechnaya estuary (56.4N, 156.1E). The first two rivers form one estuary, the Moroshechnaya river estuary is about 45 km to south. Counts of waders were conducted in the course of the Russian White Whale Program expedition of the Institute of Ecology and Evolution of the Russian Academy of Sciences. All counts were made from the end of July until the end of September and only mud- and sandflats were counted. In the Belogolovaya-Khairusovo estuary, we registered 20 wader species. The most numerous were Great Knot (15,000, maximum numbers), Red-necked Stint (5,000), Dunlin (5,000), Black-tailed Godwit (3,500), Bar-tailed Godwit (2,000) and Lesser Sandplover (2,000). In 2012, we also found 35 individually

marked Great Knots and several Black-tailed Godwits, most of them from Broome, Northwestern Australia. In Moroshechnaya estuary we registered 21 wader species. The most numerous there were Whimbrel (5,000), Great Knot (2,000), Red-necked Stint (1,500), Black-tailed Godwit (2,000), Bar-tailed Godwit (1,000) Dunlin (800), Eurasian Oystercatcher (600) and Lesser Sandplover (500). The number of Whimbrels should be seen as a minimum numbers, because this species prefer tundra-like biotops for foraging and resting rather than estuaries. Most of observed wader species use the East Asian- Australasian Flyway and are long-distant migrants. Post-breeding staging sites are very important for fueling for southward migration. Our data show that these three estuaries are such sites. Further to the south no such large wader concentrations were found and we propose that these estuaries are important fueling sites, especially for Great Knots and godwits ssp., from which waders start their journey to the south.

### How does the Amazon River influence the community structure and the size of Nearctic shorebirds wintering on mud banks of the Guianas coast?

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The coastal section of South America located between the Amazon and Orinoco Rivers (1,500 km) is considered the muddiest in the world because of the large flow of suspended sediment from the Amazon. A fluid mud is transported along the coasts of the Guianas by a complex interaction of waves, tidal forcing and coastal wind currents, forming a series of huge mud banks. These mudflats migrate one km per year and are distributed in units of 10–60 km in length and 20–30 km in width. They impose a geomorphological dynamic leading to rapid changes in shoreline and a fast alteration of facies types. Although the dynamics of these banks have been extensively studied in recent years, the state of knowledge on the organismal communities associated with these highly unstable environments is still at an exploratory stage. Nevertheless, in winter, up to 300,000 sandpipers (mainly small *Calidris* ssp.) can forage on the coast of French Guiana. Among the 21 nearctic shorebirds species censused, the Semipalmated sandpiper *Calidris pusilla* represented up to ca. 80% of all individuals counted in French Guiana in winter. Consequently, compared to other coastal wintering sites for shorebirds in the world, the coast of the Guianas support an unexpectedly high proportion of small shorebirds, with few medium-size or large-size shorebirds, except the Lesser Yellowlegs *Tringa flavipes*, which was common during migration. The questions raised by this unusual shorebird community structure are numerous, but can at first be explained by the prey availability in this unique type of very soft and dynamic mudflat. This study explores the reasons for such a dominance

of peeps among shorebirds, initially with a focus on the feeding behavior of birds. Gaining knowledge of the wintering ecology of these species is crucial, since a dramatic decline of Semipalmated Sandpipers on their major wintering areas in the Guianas has been recently observed.

### Primary moult strategies of adult Palearctic waders in Australia

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Over the past 30 years, the Australasian Wader Studies Group and the Victorian Wader Study Group have recorded the primary moult of more than 400,000 waders caught in Australia, including 21 species that migrate from breeding ranges in the Northern Hemisphere. Building on earlier work in relation to Curlew Sandpiper, we present analyses of primary moult based on Underhill-Zucchini models for the 21 Palearctic migrants all of which occur regularly in NW Australia (NWA) and for nine of the same species that also occur regularly in SE Australia (SEA). Generally the populations that carried out primary moult in NW Australia started earlier and took longer than those in SE Australia (median start date 17 September in NWA, 21 October in SEA; mean duration 138 days in NWA, 119 days in SEA). Similarly the nine species represented in both NWA and SEA all started earlier in NWA. Eight of the nine had shorter moult durations in SEA than in NWA; therefore for each species the dates on which moult finished in NWA and SEA were quite close together. The exception was Grey Plover, which started moult 21 days earlier in NWA and duration was 14 days longer than in SEA; therefore the finish date was 35 days later in SEA than in NWA. Moult durations exceeding five months were recorded in the two large *Numenius* species in NWA: Eastern Curlew (161 days) and Whimbrel (164 days). The shortest was Red Knot in SEA at only 87 days, three weeks less than the next shortest (Sanderling in SEA, 107 days). In NWA, it was evident that two species, Marsh Sandpiper and Oriental Plover, normally arrive in suspended moult, having replaced 5–8 primaries earlier during southward migration. We will discuss the factors that may lie behind the variation in moult strategies described.

### Oystercatchers adapt to declining Cockle stocks by changing their local foraging behaviour

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Oystercatchers (*Haematopus ostralegus*) are known to feed extensively on Cockles (*Cerastoderma edule*), and previous studies have demonstrated that Oystercatcher survival rates are

often dependent on changes in Cockle stocks. The Burry Inlet, South Wales, UK, is an important wintering site for waders and wildfowl, and is designated as a Special Protection Area due to its importance for a number of species, including Oystercatchers. Cockle populations have declined in the Burry Inlet, and there have been a number of Cockle mass-mortality events in recent years. There are several possible reasons for the changes in Cockle populations, but their decline is thought not to be caused by over-fishing, as has been the case in other studies. We investigate the impact of these changes in Cockle stocks on the waders that feed on them, in particular Oystercatchers. We use a combination of high-tide, low-tide and through-the-tide counts to examine changes in the local distribution and foraging habits of Oystercatchers, and ringing data to investigate the impact of declining Cockle stocks on the survival rates and body condition of Oystercatchers. Integrating data from different survey methods allows us to better understand how birds respond to changes in their food supply. After an initial decline in survival rate, the Oystercatcher population appears to adapt by finding alternative food sources that limit the impacts of further Cockle stock declines on their survival.

### Climate change and breeding waders: from impacts to adaptation

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High-latitude and upland areas in the Northern Hemisphere contain a high diversity of breeding wader species, which may be threatened by climate change. There is therefore an urgent need to assess the likely vulnerability of these species to climate change, and to consider the potential for appropriate management to reduce the severity of these impacts. To illustrate how this problem may be addressed, we review research on the potential impacts of climate change on Golden Plovers breeding in the UK, where they may be highly vulnerable to warming. Detailed research from the Peak District shows that despite increasing temperatures having an apparently short-term beneficial impact on both breeding success and overwinter survival, summer warming reduces the abundance of their tipulid prey, leading to lagged reductions in breeding success and abundance. Using comparable data from Scotland, we further test the generality of these relationships, and consider a number of other potential mechanisms by which climate change may affect Golden Plover populations. Having identified the ways in which climate change may affect a particular population, I illustrate the potential to reduce these impacts through appropriate management. In particular, we present experimental evidence to show how the management of water levels of vulnerable peatland habitats may increase the resilience of tipulids to warming, and counteract potentially detrimental effects of climate change. In addition, the control of predators and changes in grazing management may compensate for potentially negative effects of warming by also boosting productivity. We indicate the likely success of different management approaches to protect vulnerable populations to increasing levels of warming. Finally, I consider the extent to which these approaches may be applied to other species and populations.

## Disturbances and Conservation

### Stabilizing a local wader population by optimizing habitat and minimizing predation – measurements and effects

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In 2011, a project was started with the aim to stabilize the populations of several wader species breeding in an agricultural area near the Baltic coast in NE Germany. Curlew, Black-tailed Godwit, Lapwing, Redshank and Snipe all were known to breed there in steadily declining numbers. It was stated, that – as in most other wader breeding areas – agricultural activities, drainage, and predation were all factors playing a negative role. As these birds have become rare in the federal state of Mecklenburg-Vorpommern, local farmers together with nature-conservationists wanted a project to protect this special group of birds. With the construction of a gas pipeline from Russia to Germany through the Baltic Sea such a project was then started as a compensation measure. The project will run for 20 years. In an area of approx. 500 ha, mowing and grazing are used to optimize the meadows for the birds. Intensive ornithological monitoring ensures that no chicks or eggs are damaged by agricultural activities. To slow down vegetation growth (chick energy) and to offer better feeding conditions, measures were taken to raise groundwater levels. To minimize predation, meadows where chicks or nests concentrate, were protected by electrified sheep fences. The results so far are positive, but it should be taken into account that the project has run for only three years and the number of individuals has been low. The number of Curlew (ca. 8 breeding pairs) and Snipe (ca. 5) remained stable, Black-tailed Godwits increased from 9 to 14, Redshanks from 4 to >10, and Lapwings from 10 to >40 pairs breeding in 2013. In all years, the number of Redshank, Lapwing and Black-tailed Godwit fledglings per breeding pair were high enough to compensate for estimated losses in the population. In 2013, this goal was reached for Curlews as well.

### Protection of Northern Lapwing breeding sites – current state and future visions

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Northern Lapwing (*Vanellus vanellus*) reproduction is highly influenced by agricultural operations. This is especially true for nests in ploughed fields and intensively managed grasslands, which are under high risk of destruction by machinery. Therefore, it is crucial to concentrate conservation effort to provide optimal conditions supporting high hatching success, particularly of first clutches. There are two procedural options to help avoid the direct destruction of the nests by farmers – driving around them during spring field work and exclusion of farming activities

till the hatching period in entire breeding sites. In both cases, close cooperation of conservationists and farmers is essential. In 2009, direct protection of lapwing nests was implemented through the use of agricultural subsidies in the Czech Republic, and all farmers are now obliged to avoid destruction of previously marked nests. This research, aimed at the evaluation of the effect of nest marking by visible poles on nest predation, was undertaken from 2010–2013. Fifty-three pairs of equally situated nests were monitored at 16 localities in two regions. One nest in each couple was treated with two 2-m long bamboo pole installed ca. 5 m on each side from the nest. We confirmed that this marking of nests does not increase the probability of nest predation. Although the direct marking of nests can increase clutch survival, this method is demanding for both farmers and nature conservationists. For larger regularly occupied breeding sites, a new model of nest protection has been prepared as an agri-environmental scheme of the Rural Development Program 2014–2020. Farmers joining this measure should be compensated to keep a part of the field with majority of nests as fallow till the end of May. A special mix of plants shall be sown here after the 1st of June and this mixture shall be ploughed till the end of December. This large-scale approach should be a more effective way to increase chick survival.

### Habitat-specific effects of feral cat control on nest survival of the critically endangered St Helena Plover

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The St Helena Plover (*Charadrius sanctaehelenae*) is a small plover endemic to the South Atlantic island of St Helena, where it inhabits natural semi-desert and anthropogenic pasture habitat. The species suffers from nest predation by invasive mammals, prominently feral cats and rats. We examined whether controlling feral cats at the two largest breeding areas would result in higher nest survival of St Helena Plovers. In 2011 we established nest monitoring and mammal monitoring at a pasture site and a site in the semi-desert on St Helena. In May 2012, after one year of baseline monitoring, we initiated an intensive feral cat removal programme and continued monitoring nest survival and mammal abundance until April 2013. We removed 56 feral cats from the two study sites (29 in pastures, 27 in the semi-desert). Following the control of feral cats, nest survival in the semi-desert increased from 0.23 to 0.77, while in pastures nest survival increased from 0.55 before to 0.65 after cat control. In the semi-desert, we noted an increase of rabbits, but no increase of rats, while in pastures rat numbers doubled after feral cat control and rabbit numbers remained the same. Feral cats continued to re-invade both habitats and neither site could be cleared of cats despite ongoing trapping. The benefit of controlling feral cats may differ between the two habitats as a consequence of different meso-predator release effects. Removing cats from pastures may have resulted in an increase of rats and thus rat predation of St Helena Plover nests, while in the semi-desert the increase of rabbits had no negative consequences for plovers. Conservation management in pastures will therefore

require both feral cat and rat control, and thus more resources than feral cat control in the semi-desert. The benefits of feral cat control will be short-lived due to constant re-invasion, and ultimately only the eradication of invasive mammals will secure the population of St Helena Plovers.

### Understanding birds' responses to human disturbance

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Birds' responses to disturbance are interesting from a behavioural ecology viewpoint because of the recognised similarities with anti-predator behaviour. Wintering birds make trade-offs between spending time feeding (i.e. avoiding starvation) and minimising perceived predation risk, so on estuarine sites, which are often designated for their winter bird assemblages, understanding birds' behaviour in relation to disturbance can also have practical applications for conservation. Past research has shown that responses vary between species; between individuals; and over time. Two key predictors are species' body mass and environmental conditions (i.e. temperature), both of which relate to the energy costs of responding to disturbance (lost time feeding and energy costs of flight). When temperatures are lower, birds' thermoregulatory costs increase, thereby increasing daily energy requirements. Therefore birds must trade-off their responses to disturbance in order to maximise intake rates while minimising perceived predation risk. In addition to body mass and temperature, habituation, stage of the season and other factors may also play a role. In this presentation we test these relationships using data on the responses (flight initiation distance, time in flight, and time latent) to disturbance by pedestrians of ten species of wader that spend the winter on the Wash Embayment in the UK. We propose a candidate set of models that best explain the observed variations in birds' responses, and demonstrate the relative importance of different predictor variables. The results offer insights into the mechanisms behind observed plasticity in birds' responses to disturbance and support one of the predictions of the 'risk-disturbance hypothesis'. It may also be possible to use the results to estimate how other wader species using the Wash respond to pedestrians, or to extend the results to make predictions about the behaviour of wintering waders on other estuaries.

### Human disturbance impacts shorebird habitat selection and foraging at a Vancouver Island migratory stopover site

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In protected areas, there are often conflicting management objectives, mainly maximizing visitor experience while limiting impacts on wildlife. Pacific Rim National Park Reserve's 20 km of coastal beaches attract many thousands of people and shorebirds every year. Visitor use of the park is highly seasonal, with attendance peaking during the start of fall shorebird migration in July and August. To identify beach sections of high shorebird and visitor use and to determine the impact of human activity on shorebirds, we conducted shorebird and visitor surveys at 20 sites along the beach during fall migration in July to October, 2011 and 2012, and during spring migration in April to May, 2012. Over 14,000 shorebirds, 4,000 people, and 300 dogs were recorded during the 284 surveying hours. We used zero-inflated negative binomial regression to examine the influence of anthropogenic and environmental variables on shorebird presence and average time spent foraging or roosting simultaneously. Presence of shorebirds and average time spent foraging or roosting decreased with decreasing beach width and increasing number of people at a site. Furthermore, shorebirds were displaced (ran or flew in response to human or canine approach) in 37% of events where people and shorebirds were at a site at the same time and in 67% of events where people (and 100% of events where dogs) came within 50 m of shorebirds. We also handed out 348 visitor questionnaires on issues relating to off-leash dogs and shorebirds. Although most visitors agreed that off-leash dogs pose a threat to shorebirds, there was only moderate support amongst visitors for the seasonal (61%) or permanent (40%) banning of dogs from some beaches in the park. Our findings present a challenge for shorebird management at Pacific Rim as there is evidence that visitors and their dogs are displacing shorebirds and are negatively impacting shorebird foraging, yet there is little visitor support for implementing solutions.

## Curlews and Whimbrels

### Trans-Atlantic migration route of the Eskimo Curlew *Numenius borealis*

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The exact migration route of the endangered Eskimo Curlew (*Numenius borealis*) has never been established. When flocks flew over populated areas in some parts of North and South America, hunters reported their successful shooting in periodicals. They also stuffed or had a taxidermist prepare specimens for their collections. It is these records, along with scientific

collections, that provide an approximate outline of the route that spanned almost the length of two continents. Using a hypothesis from the ornithologist Fred Bodsworth, I compared his proposed migration route to the specimen records and published reports. I found that they lined up closely. The records sometimes gave the date the bird was killed so that an approximate schedule has been constructed. The mapping and timetable indicate that the best place to look for the species is along the Labrador coast of Canada in August and September. Attempting to find them on the nesting grounds is almost impossible unless a GPS tagged bird is followed. Once the species leaves Canada they were only reported when bad weather forced them to shore in the United States or the nations of the Caribbean. Their landing areas on the northern coast of South America are uncertain,

but the few specimens indicate that Venezuela and Guyana were probable destinations. Given the rarity of the Eskimo Curlew, my further investigations into this part of the migration route will be done by tagging and tracking the American Golden Plover (*Pluvialis dominica*). This bird is a migratory companion and information gathered about it will be vital to understanding and rescuing the Eskimo Curlew from extinction.

### Far Eastern Curlew is a rare nesting species of the Kronotsky reserve

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The data were collected during May–June 2013. In summer of 2011 and 2012 we checked lowlands in southern part of the reserve and found three places where Curlews were abundant. The downstream area of Kronotskaya river (N54°31'E160°38') was the most convenient place for a long-term study. This place is located between the Kronotskaya and Odessa rivers and represents a vast mossy-sedge marsh with numerous small lakes. During the incubating period 21 km<sup>2</sup> of suitable habitat were investigated. As the author worked single-handed, it should be supposed that not all of the existing Far Eastern Curlew nests were discovered. In total 11 nests and more than 30 territorial Far Eastern Curlew pairs were registered. Some nests and pairs were placed separately, but most were gathered into “pseudo colonies”. Average distance between nests was 400–450 m. The members of such colonies showed elements of social behavior. We noticed that loud alarm calls of a nesting pair, which they produce when trying to drive away a terrestrial predator, attracted birds from the neighborhood. The number of “helpers” was different depending on the part of colony where the interaction occurred. The maximum number was 13 birds. Such a crowd confused predators and made the nest finding more difficult. Most of the nests were located on small islands or island-like hummocks in lakes or in temporary water ponds. The average clutch size was  $3.8 \pm 0.13$  SE eggs per nest ( $n = 10$ ). Three clutches contained one unfertilized egg. The normal egg size varied between 66,7–77,0 x 45,5–49,3mm. The average egg size amounted to  $71.3 \pm 0.74$  x  $46.7 \pm 0.27$  ( $n = 38$ ). The first brood was observed on the 24 June and the last known nest hatched on the 29 June, respectively. The weight of newly hatched chicks was 53.4–68.1 g, with a mean of 59.2 g (SE = 1.17,  $n = 15$ ). Breeding success was relatively high: only two of 11 nests were destroyed by reindeers, the other nine nests hatched successfully.

### Determining causes of decline of the UK's breeding Whimbrels *Numenius phaeopus*

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The UK's breeding Whimbrels *Numenius phaeopus* are among Europe's most southerly, and numbers have fluctuated markedly over the last 200 years. Recently, however, there has been a rapid decline to potentially fewer than 300 pairs. The Shetland Isles hold 95% of these pairs, and declines here have been most severe on the northern isles of Fetlar, Unst and Yell – traditionally the species' core breeding areas. Further range

contraction leading to extinction as a UK breeding species is a real possibility. In 2009–2013 on Fetlar and Unst, we measured breeding success and return rates of colour-ringed adults for comparison with a study in 1986–1988 when the population was increasing. Breeding success had declined, with whole-clutch failure rates (mainly predation) almost three times higher than in the 1980s. Consequently, the mean number of chicks hatched per 4-egg clutch laid (1.77) was 33% lower than in the 1980s (2.64). Chick survival was unchanged (*ca.* 30% in both study periods), but 30% of mortality is now in chicks older than two weeks, compared with just 9% in the 1980s. Broods also moved greater distances from the nest site (up to 1.8 km) than in the 1980s, often into mires or meadows with taller vegetation that probably offered better cover from predators. The main predators in our study areas were skuas (crows were scarce, and foxes are absent from Shetland). The Great Skua population has increased since the 1980s, and although Arctic Skuas have declined, reduced sandeel stocks (and therefore fewer opportunities for kleptoparasitism of seabirds) may have resulted in greater predation pressure by both skuas on waders such as Whimbrel. However, reduced survival of Whimbrels on their Afro-tropical wintering grounds or during migration may also have contributed to the UK population decline. Return rates of colour-ringed adults (65–70%) were considerably lower than those recorded in the 1980s (89%), and this change alone is sufficient to have caused some of the observed population declines.

### Drivers of Eurasian Curlew declines in the UK uplands

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The Eurasian Curlew *Numenius arquata* is globally near threatened because of declines across the breeding range. The UK previously held 39% of the European breeding population, but breeding numbers have shown a long-term decline of 61% from 1970–2010 with a recent rapid decline of 44% from 1995–2010. In the UK, most Curlew nest in the uplands, where changes in large-scale land-use such as sheep and game management, and commercial afforestation, have altered the configuration of internationally important moorland habitat, and are proposed to increase predation pressure for ground-nesting birds. Using resurveys of Curlew breeding sites, we investigate whether upland land-use predicts low nesting success and population decline. Curlew population changes over an 8–10 year period were positively related to gamekeeper density (predator control intensity), and inversely to the area of commercial conifer woodland surrounding sites, as a source of predators to adjacent open ground. Model predictions suggest that increasing woodland cover from 0%–10% of the land area around populated sites requires an increase in human predator control effort of about 48%, to a level associated with high-intensity grouse production, to achieve Curlew population stability. Curlew nesting success, known to be a key driver of population trends, was also positively related to gamekeeper density, and inversely to the area of woodland surrounding sites, providing a plausible mechanistic link between land-use and population change. Predation pressure, determined by afforestation and predator control intensity, is currently an important driver of Curlew declines, and may be for other breeding waders. Whilst the removal of woodland from otherwise unafforested uplands may reduce predation pressure, legal predator control may be important to conserve Curlew and other ground-nesting birds in these fragmented landscapes.

## Results from a study of Whimbrel *Numenius phaeopus* at a spring staging site in England

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Prior to 2004, spring migrating Whimbrel were counted on arrival at an evening roost on Wheldrake Ings, near York, England. The results for 1987–2003 were published locally as the annual number of ‘bird-days’ which peaked at 2108 in 1997. In 2004, a research programme began to determine the length of stay of individual birds, level of interannual site fidelity, location of the birds during the day and movements of birds on either side of the staging period. During the study period (2004–2013), 106 birds were caught and colour ringed at the roost site; 16 of these birds were radio-tracked during their stay

and satellite tags were attached to four birds. In addition, DNA analyses were carried out on 68 feather samples to determine gender and subspecies. We found that the mean minimum length of stay is about ten days and that at least 53% of the birds colour ringed during 2005–2010 ( $n=97$ ) have revisited the site at least once in subsequent years. The diurnal feeding grounds have been discovered, mapped and described. Three of the satellite tags functioned successfully. Two birds were tracked to breeding grounds in Iceland whilst the third moved to Sweden. The wintering ground of one Whimbrel was established, though the transmitter failed before the bird returned from Africa. The genders of 53 birds were identified molecularly, showing that 70% of the birds were male. These results have been compared with biometric, length of stay and other data. Further DNA sequencing suggested that the birds belong to one population. Finally, it appears that the birds increased their mass by between 15–40% during their staging period.

## Physiology and Genetics

### Are migrations motivated by seasonally changing habitat preferences? Pinning down a ‘visual concept of place’ in Red Knots

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Many migratory birds show very organized circannual cycles with respect to molt & plumage, body mass, plasma corticosterone levels, preen wax composition and other easily measurable physiological characteristics. The consistent expression of these rhythms, but also the level of restlessness in captive birds that are ready to migrate but unable to take off, prompted the question: Is migration motivated by seasonally changing habitat preferences. We introduce the idea of a ‘visual concept of place’ for long-distance migrant shorebirds that maintain high levels of punctuality in their circannual rhythms (Red Knots, *Calidris canutus islandica*). Changes in habitat preference in Red Knots were tested in a ‘studio-setting’ where artificial mudflat areas were combined with projections on the walls (using LCD projectors) to visualize the contrasting winter and breeding habitats (mudflat and tundra, respectively). Preference was measured as the propensity of individuals flying towards one of two simultaneously projected images (a daily procedure, repeated ten times). By measuring this preference twice: (1) in April when the birds were physiologically not ready for northward migration and (2) in June when they were. Whereas birds in April showed a clear preference for the projected mudflat photos, most of them changed towards choosing the tundra photo in June. Our novel experimentation suggests that Red Knots, and other long-distance migrants, have a ‘visual concept of place’. This opens many experimental possibilities to study the cognitive aspects of bird migration.

### Estimating male/female proportions of effective populations in polyandrous Snowy Plovers

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Sex ratios are considered to play an important role in the evolution of mating systems. However, estimating sex ratios in the field is challenging because males and females may have different detectabilities and/or home ranges. How much males and females contribute to effective populations can be estimated using molecular markers. Population genetic theory predicts that mating systems lead to biased representation of sexes in effective populations  $N_e$ . Polygyny should lead to a female-biased  $N_e$  and polyandry to a male biased  $N_e$ . RAD sequence markers offer a new yet, rarely used opportunity to estimate  $N_e$ . Here we estimate sex ratio bias in  $N_e$  and population differentiation in Snowy Plovers *Charadrius nivosus*. Snowy Plovers are highly polyandrous: many females have two or more mates in a breeding season, whereas males tend to have a single mate. In the congeneric species, the Kentish Plover (*C. alexandrinus*), which has a very similar mating system as the Snowy Plover, we recently described a highly skewed male-biased adult sex ratio using demographic modelling. Based on these models and the mating system we predicted a male-biased  $N_e$  when examining Snowy Plovers samples from six different geographic locations. Using 1,407 sequence markers located on the autosomes and the Z chromosome, we first established that the most likely male proportion of  $N_e$  is 0.85. By contrast, we found that female Snowy Plovers contribute about four times more to gene flow than their proportion of  $N_e$  implies. Many Snowy Plover populations are declining and the species is now lawfully protected in a number of US states and Mexico. The results of our RAD analysis may have implications for

Snowy Plover conservation because we found that Snowy Plovers in Florida are genetically distinct from other North American Snowy Plovers.

### Genetic and social mating in the Dunlin *Calidris alpina schinzii*

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Inbreeding – mating between close relatives – increases homozygosity and may have negative effects on individual fitness (inbreeding depression) and ultimately the viability of the whole population. Thus, selection favoring traits enabling inbreeding avoidance, such as natal dispersal, can be expected. In highly philopatric species, kin recognition and exclusion of close kin as mates (genetic compatibility hypothesis) provide a way to escape the negative effects of inbreeding. If relatives are not recognized (or in spite of it), females may accept or even actively seek extra-pair fertilizations (EPFs) to increase the genetic quality of their offspring. This kind of social monogamy combined with genetic polygamy is especially common in birds. Here we study, during a ten-year period (2004–2013) and with 20 microsatellite loci, how genetic similarity of mates affects pair formation and EPF's in the Southern Dunlin (*Calidris alpina schinzii*). Preliminary results indicate that EP-chicks occur at a very low frequency (*ca.* 4 % of the broods) and there is no genetic pattern observable in the EP-behaviour, but certain individuals just seem to behave more promiscuously than others. However, so far, we have used only eight polymorphic microsatellite loci and have not yet completed the analyses on all of the years for which we have data. Taking into account every breeding season and increasing the number of loci to 20 should give much more reliable estimates, not only on the general

level of EPF occurrence, but also on the identity of the real parents and, most importantly, on the genetic similarity of the parents. All new loci have already been tested and are working well.

### Melanin-based coloration as an indicator of phenotypic quality in Common Snipe

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In birds, genes responsible for melanin synthesis may have pleiotropic effect on several physiological and behavioural functions. As a result, we could expect that the expression of melanin-based plumage coloration should covary with different condition-related phenotypic traits via regulation of pathogen/parasite resistance. The aim of this study was to test this hypothesis in Common Snipe, *Gallinago gallinago*, a wader that exhibits variation in the amount of black feathers in the underwing coverts. For this purpose, 830 Common Snipes were captured during autumn migration through Central Poland. We found that underwing coloration was positively correlated with all measured indices of body condition (plasma concentrations of triglycerides, total protein, and albumin). Dark underwing coloration was also associated with lower heterophile/lymphocyte (H/L) ratio, suggesting better resistance of eumelanin individuals to physiological stress. Finally, adult males with darker underwings had lower asymmetry in wing shape (wingtip convexity), which indicated their higher developmental stability. In conclusion, melanin-based coloration may be considered an honest indicator of phenotypic quality in Common Snipe.

## Alaska and East Asia – Australian Flyway studies

### You snooze, you lose: adaptive sleep loss in polygynous pectoral sandpipers

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We studied a population of male Pectoral Sandpipers (*Calidris melanotos*) breeding on the Arctic tundra in Barrow, Alaska from 2004–2012. We show how males compete intensely for access to fertile females. Using automated recording devices, we studied activity and sleep, as well as all male-female interactions. We show that males that slept the least were most successful in siring offspring, suggesting that sexual selection led to sleep loss without decreased neurobehavioural performance. We further show that pectoral sandpiper males that interact most with a particular female will also father the majority of her offspring. We report the existence of sneaker males that lack the typical male throat sac and behave as females. Finally, we discuss male characteristics and behavioral strategies in relation to mating success.

### Biparental incubation scheduling: no evidence for energetic constraints

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Incubation scheduling in birds is believed to be energetically constrained. Here, we show that this is not the case by experimentally reducing the costs of incubation in Semipalmated Sandpipers, a biparentally incubating shorebird breeding in the harsh conditions of the High Arctic. First, we decreased the costs of incubation for one parent by exchanging one of the four eggs for a thermistor-egg that heated up when the focal bird incubated. Second, we reanalyzed the data from a previous experiment where the costs of incubation were decreased for both parents by insulating the nest cup. We expected that treated birds would prolong their incubation bouts, if the biparental scheduling is energetically constrained. We found no difference in either experiment in the length of non-treated and treated

incubation bouts. In addition, there was no difference in the constancy of incubation in the thermistor-egg experiment. Taken together, these findings reveal that biparental incubation scheduling in semipalmated sandpipers is less driven by energetic constraints than previously believed and that we still do not understand the factors driving variation in the length of incubation bouts.

### Coping with the cold: physiological and behavioral adaptations of Rock Sandpipers wintering in upper Cook Inlet, Alaska

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The nominate subspecies of Rock Sandpiper (*Calidris p. ptilocnemis*) is the shorebird with the most northerly nonbreeding distribution in the Pacific Basin, common at sites as far north as upper Cook Inlet, Alaska (61°N, 151°W). The average daily temperature at this site is <0°C for nearly five months from November to March, and temperatures here commonly approach -30°C. These conditions make Cook Inlet the coldest wintering site regularly used by shorebirds, and create high energetic demands for wintering Rock Sandpipers. We initiated a comparative study to determine the physiological and behavioural adaptations that allow this subspecies to successfully exploit northerly latitudes during winter while another subspecies (*C. p. tschuktschorum*) migrates to more benign southerly locations. This comparison indicates that the two subspecies share a similar metabolic capacity: basal metabolic rates and metabolic rates as a function of cold were nearly identical between individuals of both subspecies when maintained under identical captive conditions. The nominate subspecies, however, exhibits unusual foraging-related and physiological adaptations. The *ptilocnemis* subspecies is adept at exploiting upper Cook Inlet's primary food resource, the bivalve *Macoma balthica*, and maintains high fat and lean body stores in winter. High fat stores serve to increase fasting endurance and facilitate irruptive movements to more benign locations, while increased lean tissues are associated primarily with increased digestive and thermogenic capacities. We discuss the evolution and persistence of these traits in the context of the species' apparent phenotypic flexibility, and how these traits reflect Beringia's recent dynamic glacial past.

### There are no low-quality godwits in New Zealand

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Cross-seasonal carry-over effects (COEs) can reveal annual-cycle bottlenecks and inter-individual variation in 'quality'. Alaska-breeding Bar-tailed Godwits (*Limosa lapponica baueri*) may be particularly prone to COEs, because they make three annual non-stop flights of 6,000–12,000 km each, accumulate huge fuel loads, conduct a complex molt, and breed in brief high-latitude summers. High inter-individual variation in plumage and migration timing further implies bottlenecks and individual quality differences in this system. However, I found no evidence that godwits approach the limits of their capabilities. Specifically, (1) most inter-individual variation in plumage and timing was linked with breeding latitude and defied quality-based explanations; (2) intra-individual variation in plumage and migration timing was low and apparently unaffected by COEs; (3) survival was high and individuals did not skip migrations; and (4) godwits did not appear to minimize the distance of the two longest non-stop migratory flights yet recorded. I argue that two key aspects of godwit ecology reduce apparent COEs and individual variation in performance: (1) their conservative annual cycle features slow fuelling, abundant and predictable resources, low predation risk, and ample opportunity to compensate for COEs. Also, their long lifespan predicts prioritizing migratory performance (survival) over reproductive success in any one year. (2) The unforgiving nature of their migrations implies that selection is absolute; i.e., birds migrating in poor condition are removed from the population, thereby reducing measurable COEs and variation in individual quality. These aspects call for re-evaluating the nature of expected COEs in long-distance migrants and the view that they operate close to their limits. However, it also shows the potentially fragile nature of the godwits' annual routine, in which disruption of current conditions may cause rapid collapse, rather than incremental declines.

### China's new Great Wall

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We surveyed shorebirds and their habitats along the Chinese coast from the Yangtze estuary to the Yalu River estuary on the Chinese/North Korean border during late March- mid May 2013. Extensive reclamation is taking place along almost the entire length of this coastline - in the period 2010-2020 Jiangsu province alone plans to reclaim 1,800 sq km. Whilst a considerable width of intertidal habitat remains in some areas, in others (particularly in the Bo Hai) reclamation is now extending beyond the lowtide line. Reduced intertidal habitat, lack of roosting sites (in some areas), rapid spread of *Spartina alterniflora*, widespread pollution, and competition with humans for food resources combine to create a future where shorebirds will struggle to survive without major policy changes at all levels of government in China.



## Black-tailed Godwit Studies

### The Continental European population of Black-tailed Godwits *Limosa limosa limosa* now winters closer to the breeding grounds

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Global change involves both large anthropogenic changes in habitat characteristics and climatic variations. Shorebirds will respond to such environmental changes, but we need long-term population studies to interpret their responses. Over the past few decades, the Continental European population of Black-tailed Godwits, *Limosa limosa limosa* has declined largely because of agriculture intensification on their Dutch breeding grounds. Numbers have also declined in wintering areas in West Africa. However, in Doñana (southwest Spain), high numbers have recently been recorded. We analyzed the changing numbers of godwits and the environmental context over the last 35 years. The time series analysis suggests a step increase in numbers present in winter. These changes were not explained by climatic conditions in Doñana nor in West Africa, but were associated with the creation in 1994 of fish farms on former natural marshes. Artificial wetlands, which are flooded even in dry seasons, may provide predictable foraging resources during the entire non-breeding season. These results suggest that resource availability, rather than climate, drives non-breeding distribution of godwits and illustrates how quickly shorebirds may respond to anthropogenic change, even in positive ways. We discuss the ecological consequences of wintering closer to the breeding areas in the context of global change.

### When Siberia comes to The Netherlands: the response of Continental Black-tailed Godwits to a record cold spring

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While many migratory bird species are able to anticipate weather conditions along their migration routes and adjust their progress and behaviour accordingly, there are numerous instances of extreme weather events surprising birds mid-migration. These occurrences can act as strong selection events and dramatically affect population dynamics in small populations. Global climate change is predicted to increase the frequency with which extreme weather events occur and lower

the predictability of longer-term conditions from season to season. As such, migratory birds may have to increasingly respond to adverse conditions during inherently stressful periods of their annual cycle. During March and April 2013, Western Europe experienced a prolonged period of record low temperatures and rainfall, coinciding with the northward migration and pre-breeding period of Continental Black-tailed Godwits *Limosa limosa limosa*. We documented the response of Continental godwits breeding in southwest Friesland, The Netherlands to these conditions using a combination of tracking devices, foraging observations of focal individuals, measurements of food availability, and larger-scale efforts to resight colour-marked individuals and quantify godwit aggregations in the region and compared these measures with data from our long-term study of this breeding population. We found that different individuals used different response mechanisms – including stalling migration, reversing migration, using novel habitats and sites, and increasing foraging effort – to survive the period. Despite these energetically costly responses and the severity of the conditions, we subsequently found that levels of both breeding propensity and success were high. This suggests that short-term inter-seasonal interactions were limited and that godwits have considerable behavioural plasticity with which to deal with adverse conditions, but that the long-term consequences of such responses are not yet known.

### Early-season decision-making of Continental Black-tailed Godwits: when and where to breed in relation to food resources?

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After arriving on their breeding grounds, Continental Black-tailed Godwits (*Limosa limosa limosa*) must decide when and where to breed. According to life history theory, food availability is an important factor in determining the timing and location of breeding. In Black-tailed Godwits in southwest Friesland, The Netherlands, we tested whether the duration of the pre-breeding period and the selection of breeding territories were explained by the availability of earthworms (Lumbricidae) and surface-dwelling invertebrates. Although godwits feeding in earthworm-rich meadows had higher rates of foraging success, food availability was not correlated with the duration of the pre-breeding period in our 100-ha study area. We also found no relation between breeding location and proximity to food resources. These results contrast with previous research on the ecologically similar Northern Lapwing (*Vanellus vanellus*), and counter the widely-held notion that fertilizer-driven earthworm abundance is a critical resource for breeding Black-tailed Godwit.

## Effectiveness of meadow bird protection in Germany

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In spite of considerable financial efforts for the establishment of reserves and especially for agri-environmental schemes, the population sizes of waders breeding on wet grassland (meadow birds) are still declining in Germany and many other European countries. A recent analysis based on monitoring data of several meadow bird species at more than 50 sites in Germany revealed many failures, but also some successes. The factors associated with successful protection differed between species. The results revealed most often were water table, protection of nests and broods from harmful farming activities and time spent in monitoring and management of the site. Some successful examples for meadow bird protection outside reserves are presented: “nest and brood protection” (beneficial to Black-tailed Godwits and Curlews) and the “whole farm approach” (beneficial to Lapwings and Black-tailed Godwits). The analysis and the examples show that the amount of time spent caretaking was often a crucial factor for the success of meadow bird protection.

## The Black-tailed Godwit LIFE-project in the Hetter area, Germany: measures, population dynamics and future prospects

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The Hetter is a grassland dominated nature reserve of 650 hectares, close to the border with The Netherlands in North-Rhine-Westphalia (NRW), Germany. It is part of the Special Protection Area “Lower Rhine Area” which includes more than 25,000 hectares. So it is one of the oldest and largest protected areas in NRW. It has a nationwide importance as breeding site for Black-tailed Godwits and other meadow birds, as well as for roosting and wintering birds. The Hetter holds up to 20% of the Black-tailed Godwit’s (*Limosa limosa*) breeding population of NRW. Since 2009 the NABU-Naturschutzstation e.V. and the Naturschutzzentrum im Kreis Kleve e.V. has carried out a LIFE+ project to protect the Black-tailed Godwit and other meadow birds in the Hetter. Between 1970 and 1995 the local population of Black-tailed Godwit declined from 180 to 50 territories. From that time the number of territories were stable at a low level between 25 and 50. Since the beginning of this LIFE+ Project in 2009 several measures were realized: buying property, laying out a ring system of rimmed furrows aiming at a water regulation, laying out flat lands and optimizing existing ponds or embankment degradation. Additionally, an “extensive grassland management plan” has been implemented in the course of the project period. The number of nests found indicates that Black-tailed Godwits strongly prefer fields that are extensively managed. The effect of prospective measures, population dynamics and breeding success are discussed considering the meaning of extensively managed fields, and further steps in the project are presented.

## Workshop on Geolocator and GPS Studies

### Geolocator developments – IWSG 2013 geolocator workshop

**James Fox**

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Light-level geolocators are a relatively recent technology in automated electronic data logging for animal movement studies. One of the main advances over recent years is a reduction in size while retaining the same quantity and quality of information storage. This has made the technology accessible to researchers wishing to study migratory movements of smaller avian species. An overview will be given of the factors involved in minimising logger weight and of attachment methods. The talk will also mention current and possible future hardware developments.



### Highlights from geolocator studies of waders

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It is six years since geolocators were first deployed on migratory waders. Since then they have been used on nearly 30 species worldwide. Attachment has been with leg-loop harness or via a plastic/metal leg band or leg flag, though harnesses were generally not successful on medium size waders which gain very large amounts of fat for migration. Geolocator results have greatly enhanced the insight into wader migration strategies, generating much previously unknown information. The capacity for long non-stop flights in many species has been further demonstrated, particularly on the first leg of a migration. Course can change direction from one leg to another with the overall path between breeding and non-breeding (wintering) areas not always following a great circle route. Stopover durations range widely, from a few days to over five weeks. Individuals follow closely similar migration routes and timing each year although these can vary considerably between northward and southward migrations. Flight speeds vary widely, from 30 km/hr. up to 85 km/hr. (97 km/hr. for Great Snipe), mainly as a result of wind

conditions. The average achieved is close to 50 km/hr., rather less than assumed in many flight range calculations. Other ancillary data collected includes detailed information on breeding phenology including the revelation that repeat clutches, after nesting failure, may be more common than previously recorded. In the future, technical advances in geolocators and in the analysis and interpretation of data recorded are likely to overcome some of the current shortcomings, such as the inability to determine exact breeding locations in the continuous daylight in the arctic and inaccuracies in position around the time of equinoxes. The limitations in geolocator use by the need to recapture birds, to retrieve the instrument, would be overcome if a remote downloading capability could be developed. An ability to determine the height at which a bird is migrating would also be beneficial to improve our understanding of wind interactions and flight dynamics.

## Precision and accuracy of geolocators

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Geolocators determine latitude and longitude from the timing of transitions between light and dark (sunrise and sunset). Errors can arise through variations in the transitions due to, for example, variations in cloud cover. As a result, geolocations are inexact. There are two aspects to error. One is a lack of precision (inconsistency of locations). The other is a lack of accuracy (difference from the true location). To describe precision and accuracy in geolocation, I examined runs of data for latitude and longitude when birds were likely to be sedentary at the marking location. Median values and inter-quartile ranges were calculated for ten purple sandpipers prior to migration and in winter. Precision of about one degree in the IQR was found to be typical for most birds. A comparison between the marking locality and median geolocation showed that accuracy varied and there was a systematic error of about one degree of longitude.

## Study of Red Knot breeding biology in the sub-Arctic with the help of geolocators

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Few details of Red Knots (*Calidris canutus*) breeding biology are known because of the species' secretive behaviour on their breeding grounds. Results obtained from recordings of light-sensing geolocators applied to three Red Knot males (*C. c. rogersi* subspecies) in southern Chukotka, Far Eastern Russia, have revealed the possibility of gathering important information not only about bird migration, but also about some details of

their breeding behaviour and phenology on the breeding grounds. Daily dark period (= nightshade) lasts for about 4 hours at this latitude (N 62,5 deg) in summer, but both typical incubation and off-duty bouts last for 6–12 hours in Red Knots, thus making it possible to increase the sample size for the measurements of these parameters if start and/or termination does not fall during a nightshade period. Incubation behaviour as indicated by geolocator data has been confirmed by direct observations. It turned out that the daily median signal of the geolocator data is the best matching indicator to estimate the incubation period. However, estimated incubation periods differ from observed ones suggest that birds may potentially spend at least a day of incubating an incomplete clutch and half a day of warming hatched chicks in the nest. The involvement of females in incubation seems to be shorter, but exact information is missing. Other parameters derived from geolocators data are arrival and departure dates, and the duration of post-breeding periods spent on the breeding grounds. The latter was longer in *C. c. rogersi* than in *C. c. rufa* from high-Arctic Canada. The complete absence of salt water contact while the birds are on the breeding grounds, as measured using conductivity sensors on the geolocators, is surprising taking into account the coastal position of the study area.

## New technologies – new insights – new challenges

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Light-based geolocators are simple animal-tracking devices allowing the reconstruction of global positions based on light intensity recordings over time. Since geolocation devices are potentially smaller and much cheaper than GPS devices, the technology has been taken up enthusiastically by the ornithological community. The opportunity to track birds weighing even <60 g has produced important new insights into movement ecology of small birds, such as waders and songbirds. However, there has been a lack of communication about standardized and scientifically appropriate analysis tools, which account for a variety of sources of errors inherently connected to geolocation by light. Recently, an increasing number of analysis tools have become available, enhancing the usability and flexibility of geolocator data, yet some of these tools also come with possible disadvantages. Here we present an overview on the methods provided in these tools. Furthermore, we discuss their applicability in the light of different requirements determined by research hypotheses. Applying the appropriate tool (incl. method) for a working hypothesis and collecting reproducible statistically sound outputs is crucial for analyses to be objective and transparent. Transparent methods allow other researchers to actually reproduce a study and confirm or disconfirm the working hypothesis for their own study species. Choosing the right tool will allow an increase in the complexity of questions (hypotheses), that can be investigated. This will guarantee more new and exciting insights into avian migration.



## Workshop on the decline of the Eurasian Oystercatcher in NW Europe

### Population processes in the Eurasian Oystercatcher

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Eurasian Oystercatchers are in decline in many parts of Europe. Yet, numbers are stable in some parts of the UK and even increasing in Iceland. What is causing these disparate population trends? Are they due to processes in the breeding areas, in the

wintering areas, or both? What are the impacts of climate change, land use changes, shellfish fisheries etc.? The aim of the workshop is to bring together scientists whose studies may shed light on these questions. Anyone feeling he or she can make a contribution is welcome. Contributions may range from a few slides on local trends to detailed demographic analyses of the impact of climate change to proposals for a better organization of colour-marking schemes to insights derived from studies on Oystercatchers with GPS-loggers. Hopefully, we can formulate a series of hypotheses and a research agenda, including the potential contribution of colour-marking schemes.

## Workshop on the conservation of the world's Numeniini species

### Status and conservation needs of the world's Numeniini species

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On Monday 30 September there will be the first ever global workshop to review the knowledge on, and conservation needs of, the world's Numeniini species; as well as all Numenius and Limosa species, this will include consideration of Upland Sandpiper. For each biogeographical population, the workshop will compare and contrast what is known about the population ecology, status, pressures and conservation responses. It will identify key gaps in information and make recommendations

regarding priorities for conservation action. Most of the information will be compiled in advance by Dan Brown from the information supplied by volunteers on the species/biographic populations on which they have knowledge, especially via a proforma circulated by Dan. The compiled information will be circulated to participants and other experts a month in advance of the workshop to allow time for further gaps to be filled and proper consideration of the material. The workshop itself will not have presentations on individual species but will largely take the form of guided discussion of the spreadsheet, confirming facts, filling any gaps, discussing implications of the data and reaching agreement on action needed. The outputs of the workshop will be a draft paper for a peer-reviewed journal and a recommendation to the Scientific Council of the United Nations Convention on Migratory Species, the Technical Committee of the African-Eurasian Waterbird Agreement, the East Asian Australasian Flyway Partnership, the Western Hemisphere Migratory Species Initiative and the Western Hemisphere Shorebird Reserve Network.





# International Wader Study Group Conference

## Abstracts of Posters

### Predicting the effect of invertebrate regime shifts on waders

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With ever increasing pressure being placed on ecosystems to keep up with environmental change, it is important to understand the consequences of environmental change quickly and accurately. Each stress event raises the chance that a regime shift may occur, leading to changes in an ecosystem's species composition and affecting population dynamics in higher taxa. Wading birds are such an example, as they are dependent on certain size-classes of invertebrates and shifts in the abundance of prey sizes could affect the carrying capacity of a habitat. Estuarine systems vary in their composition and structure, but nearly all of them have an area of intertidal mudflat that waders forage upon. These areas provide vital resources to wading birds throughout the year, but particularly during winter when they must sustain their body condition in preparation for the next breeding season and associated migratory movements. Contamination of the water column can have an impact on the growth rates of benthic invertebrates, causing changes to total length, recruitment rates and, in some cases, localised extinction. In addition, bait digging and shellfishing can also impact invertebrate communities. Any of these changes could generate a regime shift in the invertebrate community of the sediment and, thus, the availability of prey to foraging birds. Individual-based models (IBMs) collate survey and research data to predict survival and distribution across habitats via modelling the fitness maximising decisions of individuals. Often surveys carried out to determine invertebrate biomass do not take size class into account when sampling. Here, we show how an understanding of invertebrate size class distribution can lead to an IBM that accurately predicts overwinter wading bird survival in an estuarine system. We describe how waders would be affected by regime shifts using a previously developed model of Poole Harbour. Without knowing the distribution of invertebrate size classes we would not have been able to understand these population effects.

### The halophite grassland importance for the Mountain Plover *Charadrius montanus* in the Northeast Mexico

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The Mountain Plover breeds in the grasslands and high plains of the western USA and winters in north Mexico. However there are some supposedly resident populations in the halophite grasslands of northeast Mexico. The objective of this study was to evaluate the populations of Mountain Plovers in this part of the country. We estimated the population size between 2003 to 2006 at eight sites in northeast Mexico. We used the distance sampling method to evaluate breeding density. Number and length of transects were related to the size of the respective site. Each site was visited at least once per season. Density was estimated by year and season (summer and winter) using Distance Beta 5.0 software. The summer average densities differed significantly between 2004 and 2005 (0.03 and 0.08 birds/ha, respectively;  $t = -5.098$ ,  $p = 0.014$ ). The winter density was higher at the site in La Soledad than at La India, El Manantial, El Gallo or La Trinidad ( $t = 4.235$ ,  $p = 0.024$ ). We can think of two possible, non-mutually exclusive explanations: (1) migratory and resident populations concur in La Soledad or (2) the winter population includes birds born in the summer in Mexico. We do not know if the "resident" populations winter in the study area or migrate to other parts of the country. The wintering population in our study area comprises about 10% of the total Mountain Plover population, and the breeding population represents an additional 4%.

### The effect of protective measures to the Black-tailed Godwits in the nature conservation area 'Hetter-Millinger Bruch'

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The nature conservation area Hetter-Millinger Bruch (650 hectares) is representative of the traditional, rural landscape in the Lower Rhine area. It is located close to the border to The Netherlands in North-Rhine-Westphalia (NRW), Germany. This area, which is dominated by grassland, protrudes into The Netherlands at two sites: "Großer Hetterbogen" and "Kleiner Hetterbogen". The site is managed by the NABU-Naturschutzstation Niederrhein e.V. and the Naturschutzzentrum im Kreis Kleve e.V. The Hetter is part of the EU bird protection area "lower Rhine". The aim of this LIFE project is to improve the habitat conditions for endangered wet grassland habitats on more than 25,000 hectares, and is one of the largest and most important breeding, roosting and wintering sites for birds in NRW. *Limosa limosa* has been chosen to be the LIFE+ Project's management indicator species in the Hetter, as it demands high standards of its wet grassland habitat. Currently, the Hetter accommodates the largest and most significant population of *Limosa limosa* in NRW. In 1970, the local population (ca. 180 breeding pairs) was much higher than now. For more than ten years, the number of territories has been stable at a low level between 25 and 50. We assume that this stabilization is due to

the development of less intensively managed grassland fields and additionally implemented protective measures (e.g. restoring and creating shallow depressions and optimising existing ponds) important for meadow birds, especially for Black-tailed Godwits. After having carried out different protective measures in the beginning of this project, numbers of Black-tailed Godwits have been increasing. We discuss such a successful repopulation in the “Kleiner Hetterbogen”, with an emphasis on the importance of nature conservation measures

### The Red Knot decline in the Western Hemisphere: is there a lemming connection?

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Western Atlantic Red Knot *Calidris canutus rufa* numbers have declined since 1980 with a sustained downward trend observed after 1998. Because the reproductive output of a closely-related Eurasian subspecies *C. c. islandica* is known to be low when lemming numbers are low, and because lemming cycles in Fennoscandia were recently interrupted, we investigated the relationship between the rodent cycle in Arctic Canada and numbers of *C. c. rufa* migrating through the United States. Shooting records from Cape Cod in the 1800's and Red Knot counts on the Delaware Bay from 1986 to 1998 cycled with four-year periods. Annual peaks in numbers of Red Knots stopping in the Delaware Bay in 1986–1998 occurred two years after arctic rodent peaks more often than expected at random. The results suggest that *C. c. rufa* reproductive output was linked to the rodent cycle before the Red Knot decline. There is no evidence that such a link existed after 1998. These findings are consistent with the hypothesis that an interruption of the rodent cycle in red knot habitat could have been a driver in the recent Red Knot decline. Field studies in the Arctic are needed to further investigate this hypothesis.

### Restoration and public access of an urban coastal meadow complex in Pärnu Town (URBANCOWS)

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Boreal coastal meadows is a habitat type listed as a priority habitat under Annex 1 of the EU Habitats Directive. The Pärnu coastal meadow complex, which consists of boreal coastal meadows, coastal lagoons and dunes, located inside an urban environment, is itself spread over more than 250 ha (including buffers, it amounts to 371.4 ha). The overall goal of the project is to improve the favourable conservation status of the coastal meadow and lagoon habitats in Pärnu, as well as the species characteristic of this habitat complex. This will be achieved through sustainable management of the Pärnu coastal meadow and lagoon habitat complex and raising the awareness of the local community, as well as the visitors of Pärnu, about the natural value of the area. The aim of the project is to establish necessary infrastructure (steady fences, shelters etc) for grazing

cattle in the urban environment and prepare the area for future management, by restoring the habitat complex of coastal meadow and lagoons..

### Sakhalin Island as important stopover sites for Spoon-billed Sandpiper *Eurynorhynchus pygmeus*

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The Spoon-billed Sandpiper *Eurynorhynchus pygmeus* (SBS) is considered to be one of the most endangered birds in the world. The IUCN Red List status of the species was upgraded to Critically Endangered in 2008. With a breeding population that may now be less than 100 pairs, the species is in real danger of extinction. SBS migrate along part of the East Asian-Australasian Flyway, following the Asian Pacific coast between their breeding grounds in the coastal tundra of North-East Russia and their wintering sites in southern and South-East Asia. One of the most frequent places where SBS has been known to stage on spring and autumn migration is Southern Sakhalin, Russia. Counts of up to 200 birds (on 30 May 1979) have been documented (Nechaev 1991), but only single individuals have been seen in recent years (Zykov & Revyakina 1996; Tiunov & Blochin 2011; Ktitorov 2012). Based on published data we have compiled a database of all SBS records on Sakhalin. In May 2012, we studied the stopover of waders with a special search for SBS in Lososey Bay (Southern Sakhalin). SBS were seen six times and as many as five to nine different individuals were seen at once. An analysis of published and original data of SBS records on Sakhalin Island demonstrated that this area is still an important staging site for SBS on their migration, but numbers of record SBS confirm a rapid and continued population decline in this species.

### Comparing avian biodiversity in different habitats in South Iceland

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In a world of rapid anthropogenic land-use changes and declining biodiversity, there is an urgent need for understanding the state of biodiversity to aid management and conservation. Knowledge about biodiversity in Iceland is limited, particularly in the light of accelerating land use changes, which rate among the most rapid in Europe. In this study, we assessed the importance of different habitats for avian biodiversity by surveying 200 random sites in the lowlands of South Iceland and linking these to land uses attained from the Icelandic Farmland Database. Birds were surveyed in the five most common vegetated habitat classes, other than agricultural land: wetland, semi-wetland, rich heathland, grassland and poor heathland. In total, 5,128 individuals of 22 species were recorded and 95% of these belong to eight species, seven waders and the Meadow Pipit (*Anthus pratensis*). Of those eight species, five – (Dunlin (*Calidris alpina*), Snipe (*Gallinago gallinago*), Whimbrel (*Numenius phaeopus*), Black-tailed Godwit (*Limosa limosa*) and Meadow Pipit) – occurred in the highest densities in wetlands,

but Oystercatcher (*Haematopus ostralegus*) and Redshank (*Tringa totanus*) occurred in the highest densities in grasslands, and Golden Plover (*Pluvialis apricaria*) in poor heathland. Total density of the eight species in the five habitats ranged from 274 individuals per km<sup>2</sup> in poor heathland to 640 individuals per km<sup>2</sup> in wetlands. Different measures of the avifauna in South Iceland suggest that wetter habitats are of greater importance for birds than the drier ones. Despite the importance of wetlands for avian and other species, human actions have extensively promoted the loss of these habitats with inevitable negative consequences to biodiversity.

### Morphological characters of the Kentish Plover *Charadrius alexandrinus* on the southwest coast of Korea

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We studied the morphological characteristics of the Kentish Plover (*Charadrius alexandrinus*) on the southwest coast of Korea (N34°47', E126°24' ~ N37°24', E126°36') during April–May of the 2012 breeding season. Historically, two subspecies, *C. a. alexandrinus* and *C. a. dealbatus*, have been recorded in this area. We captured 45 individuals (14 males and 31 females), measured biometric characteristics, and took photos. Two types of characteristics appeared based on the morphology: Dark lore feathers do not spread to the forehead above the beak. So, the area between the forehead and bill looks more white. We divided the results by sex and compared bill sizes. Previous studies of these two subspecies had also shown differences in these characteristics. Therefore, it is necessary to re-investigate the classification of the two subspecies in South Korea.

### The functional response of female Bar-tailed Godwits *Limosa lapponica*: an experimental approach

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Bar-tailed Godwits are highly sexually dimorphic shorebirds, in which the bill length of females is on average 25% longer than that of males. Female Bar-tailed Godwits suffered from interference competition in the field at high densities. High density of foragers could induce prey depression in Lugworms *Arenicola marina*, which might in turn influence intake rates. We investigated the assumptions underlying the type II functional response for female Bar-tailed Godwits using an experimental design. Depth was incorporated to investigate the potential effect of prey depression on intake rate. Five experimental birds were used to study the effect of prey burying depth and prey density. Search time (Ts) per prey decreased signifi-

cantly with increasing prey density and increased when prey were buried at greater depth. Search time declined inversely with prey density (D), since the coefficient was close to -1. Handling time (Th) was independent of prey density and negatively influenced by prey length; burying depth did not have a significant effect. However, the interaction of prey length and burying depth did have a significant negative effect on handling time. The instantaneous area of discovery was independent of density. Therefore, the functional response of female Bar-tailed Godwits corresponds to the type II functional response. However, further observations suggest that female Bar-tailed Godwits are most likely not limited by handling time, but digestively constrained. The results indicate that a greater prey depth results in a lower intake rate, due to longer search time, and thus a higher threshold of acceptable harvestable biomass. This supports the hypothesis that prey depression influences the intake rate of Bar-tailed Godwits.

### Body condition of Northern Lapwing chicks in different habitats of agricultural landscape

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The early post-hatching stage is one of the most vulnerable parts of the avian life cycle, especially in precocial birds. The Northern Lapwing (*Vanellus vanellus*) is a possible model species for the investigation of precocial shorebirds breeding in human-altered landscapes. In fact, the current population declines in several European wader species seems to be caused by reduced chick survival. In the Czech Republic, the number of lapwings have declined by 85% since 1982, similar to many other European countries. Nowadays, the majority of birds breed in various biotopes in arable land, including intensively managed fields. We measured 96 Northern Lapwing chicks from 44 families at 37 localities in diverse habitats of farmland in South and East Bohemia, Czech Republic, during the breeding seasons of 2012–2013. Only chicks which had already spent time in a particular habitat were included in the analysis. Preliminary results showed that body condition of the chicks older than ten days wasn't significantly different from younger chicks. Chick condition wasn't significantly influenced by habitat type, but we found moderately positive effect of wet patches in chick-rearing habitat in 2012. Condition of chicks in 2013 was 0.2× higher than in the previous year, presumably due to high precipitation in May and June 2013. More favourable weather in 2013 probably overruled possible differences among habitat types and diminished the effect of wet patches, which were particularly important with limited rainfall in 2012. Larger sample sizes are necessary to reveal differences in habitat quality and additional years of study needed to improve detection of weather's influence on chick body condition. A better understanding of the lapwing chick's survival and condition in different habitats will deepen our knowledge about ecological constraints and adaptations of precocial shorebirds and, at the same time, help determine effective conservation rules of this endangered species.

## A stable isotope approach to unravel wintering and migration strategies of Ruffs *Philomachus pugnax* staging in The Netherlands during northward migration

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The Ruff is an inland shorebird using the Palearctic-African migratory flyways. Over its western range, the population has sharply declined. Mainly used by males, the western route links the floodplains of Sub-Saharan Africa to the Scandinavian and Russian tundra via the low grasslands of The Netherlands. However some males are known to winter closer to the breeding grounds, in Western Europe. Using stable isotopes, we aim to improve our understanding of the contribution and migratory strategies of different wintering populations (Sub-Saharan vs. European) to the most western staging site of Ruffs. Throughout spring migration 2012, we collected winter-grown feathers and blood from 168 male Ruffs passing by South-West Friesland, The Netherlands. Based on a cluster analysis from stable isotope ratios of hydrogen, carbon and nitrogen (d13C, d15N, d2H) in winter-grown flight feathers, we found that Ruffs wintering in sub-Saharan Africa contribute most to the current spring passage population of Ruffs in the Netherlands. Further, stable isotope ratios of d13C in both, plasma and red blood cells of sub-Saharan wintering Ruffs were found to fall in the range of the expected stable isotopic signature for plasma and red blood cells synthesized in Europe. Thus, sub-Saharan Ruffs do not fly non-stop from Africa as it used to be thought and, hence, must use intermediate wetlands on the way before reaching the Netherlands. Considering the species ecology and related confounding factors, we discuss the strength of our results and the suitability of stable isotopes to infer Ruff wintering origin.

## Breeding communities of waders in Svjatoj Nos marshlands, Lake Baikal, Russia

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Marshlands at Lake Baikal support significant breeding populations of various wader species, including Siberian endemics such as *Calidris subminuta* and *Limnodromus semipalmatus*.

In 1993 and 2013 we mapped breeding waders in a study plot of ca. 140 ha located on the Svjatoj Nos isthmus between Barguzinskij Bay and Lake Arangatuj (ca. 53.56°N, 108.95°E). In 1993, we recorded 106 nests and breeding territories of eight wader species. In 2013, despite markedly higher efforts of a greater number of fieldworkers, we registered only 24 nests of five wader species. In addition, two territories of *G. gallinago* were located, but breeding of this species was not proven in 2013. Several individuals of *T. stagnatilis* and *L. semipalmatus* were seen in 2013, but these species probably did not breed in or near the study plot. Breeding numbers were as follows: *Tringa glareola* 25 nests or breeding territories in 1993/4 nests or breeding territories in 2013, *Gallinago gallinago* 20/2, *Tringa stagnatilis* 18/0, *Vanellus vanellus* 13/8, *Philomachus pugnax* 12/2, *Limnodromus semipalmatus* 11/0, *Numenius arquata* 5/5 and *Calidris subminuta* 2/5). The markedly lower abundance of breeding waders and loss of two breeding species in 2013 as compared with 1993 may reflect unsuitable breeding conditions in the Svjatoj Nos marshlands (e.g. plant succession, increased number of predators), different impact of weather conditions or negative effects of conditions during migration and/or in wintering areas. Further research is planned to clarify these changes.

## Trends of Numeniini populations in France during the non-breeding period

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French wetlands are at the crossroads of several shorebirds' flyways. During the non-breeding period, these wetlands host four Numeniini species: Black-tailed Godwit *Limosa limosa* (migration & winter), Bar-tailed Godwit *Limosa lapponica* (migration & winter), Curlew *Numenius arquata* (migration & winter) and Whimbrel *Numenius phaeopus* (migration). Except for the *islandica* subspecies population of Black-tailed Godwit, populations have decreased at the European scale, while in France, the occurrence of these species in winter is increasing. Here, we explore national trends of mid-January IWC (International Waterbird Counts 1979–2012) and monthly counts on key coastal sites (2001–2012) to understand these positive trends. In the last ten years, Black-tailed Godwit numbers have increased from 10,000 to 20,000 individuals. Both Curlews and Bar-tailed Godwits seem stable in midwinter. Moreover, we observed an increase in the over-summering population of Bar-tailed Godwits. Numbers of staging Whimbrels, at the end of summer were also increasing. IWC counts highlight the importance of the French wetlands as refuge for Curlews during cold spells (hosting from 20,000 to 60,000 individuals). Black-tailed Godwit and Curlew have been protected by a hunting moratorium during the past six years (2007–2013). We suggest that the moratorium has greatly improved the status of these species, but also positively affected the two other hunted species, Whimbrel and Bar-tailed Godwit. They potentially have been spared by hunters due to the high risk of identification mistakes. If climate change leads to a further concentration of shorebird along the French coasts, European populations might be caught in the mousetrap of French lobby of 'traditional' hunters.

## Preliminary molecular analysis of the Iberian breeding population of the Eurasian Curlew *Numenius arquata*

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Peripheral populations are characterized by low genetic diversity, which makes them vulnerable to environmental changes and stochastic events. Geographic isolation might also lead to population diversification, elevating the importance of these populations for conservation. Although common in many parts of its breeding range, the Curlew suffered a contraction of its breeding range during the past few decades in Iberia and is currently reduced to a minuscule population of four breeding pairs in Galicia (NW Spain). To test the divergence of the Iberian Curlew from European populations, we sequenced a 750 bp fragment of the mtDNA ND2 gene for 24 samples (eggshells, growing feathers, or muscle tissue) collected during breeding season in Spain (n=9), Germany (n=7) and Sweden (n=8). We identified a total of five unique haplotypes, but all Iberian samples shared the single most common haplotype, which was also shared by five German and three Swedish birds. Therefore, the genetic diversity of the Iberian population is reduced relative to the continental populations but there is no evidence for divergence from the German ( $F_{st}=-0.01$ ,  $P=0.65\pm 0.07$ ) or the Swedish ( $F_{st}=0.13$ ,  $P=0.22\pm 0.03$ ) populations. Presented data are preliminary and future assessment of the isolation, genetic diversity, and effective population size of the populations will include more localities and microsatellite analyses.

## Distributional changes in Ruffs staging in southwest Friesland (2003–2013)

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Numbers of northbound migrating Ruff *Philomachus pugnax* in southwest Friesland, The Netherlands, have strongly declined over the last two decades. The population decreased by 66% in the period from 2001–2010, amounting to a loss of 21,000 individuals. Wet grasslands, favoured by fueling Ruffs, are increasingly rare in the predominantly intensive agricultural landscape. Yet, conservation actions for (breeding) meadow birds have led

to the creation of inland wetlands, beneficial for both roosting and foraging. This study aims to understand how habitat selection in Ruffs might have changed in the last decade. In spring 2013, we re-investigated the occurrence of Ruffs, and collected a set of farming and landscape parameters to compare their recent spatial distribution patterns to the situation ten years ago, in spring 2003. Additionally, we mapped the observations of our long-term mark-resighting monitoring project over the period 2006 to 2013. Results show that, in 2003, two agricultural management components (i.e. intermediate groundwater levels and recently manured meadows) seemed to drive habitat selection in Ruffs. In 2013, Ruffs mainly preferred meadows closer to wet roosting areas even if the meadows were intensively managed. Nevertheless, they avoided dry liquid manured fields. The distribution of colour-ring resightings since 2006 confirms that Ruffs progressively concentrated in the centre of the study area where, among the intensive farming fields, new wet areas were created that served as day- and night-time roosts.

## Migration of Ruffs *Philomachus pugnax* in the south of West Siberia

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The Ruff is a common passage migrant in the Baraba forest-steppe of the south of West Siberia and a very rare breeder. From 1973 to 1996, captures by mist net, ringing and counts was carried out in different habitats. After 1996, only counts on lakes were done. In spring, the first males appeared in Baraba forest steppe between 19 April and 2 May. The first females were observed 6–9 days later. Male bias (65–80%) among migratory Ruffs was observed until the second decade of May. In the third decade, the proportion of females was about 60% and in the first decade of June, 80%. In spring Ruffs stopped on the wetlands in Baraba forest steppe according to rattraps for up to ten days. There were significant differences in the timing of passage between age/sex classes through the forest steppe during southward migration. Southward migration of Ruffs starts at the end of June with adult males and up to the middle of July the proportion of males amongst all adults was about 90%. Adult females migrate mainly in August. Juvenile birds migrate from the second half of July until the end of September. Among first year birds captured by mist-nets, the proportion of males was 30% up to the end of August and 60% in September. During southward migration, the stopover duration near the ringing site lasted up to 20 days (average 9) for juvenile females and up to 9 days (average 4.5) for juvenile males. The average rate of body mass gain was 1.2 g per day in juvenile females. Over the past 40 years there is evidence of a pronounced decrease in the number of migrating Ruffs, by 20–30x, during spring and autumn migration.

