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Choi C-Y, Jackson MV, Gallo-Cajiao E, *et al.* Biodiversity and China's new Great Wall. Divers Distrib. 2018;24:137–143. https://doi.org/10.1111/ddi.12675

(Abstract)

Coastal armouring and the reclamation of intertidal areas through the use of seawalls and other artificial structures has been practiced for thousands of years, but its recent expansion in China and elsewhere in Asia has been unprecedented in its rate and intensity. One result has been the recent loss of nearly two-thirds of tidal flats in the Yellow Sea, a globally unique ecosystem of high ecological value. The severe effects on biodiversity of the recent large-scale coastal land claim activities in China are well documented, yet some recent studies have emphasized the ecological opportunities provided by such artificial coastal infrastructure in China, in some cases suggesting that the ecological impacts of coastal infrastructure should be reconsidered due to benefits to some rocky shore species in a changing climate. This is cause for concern because, while studying the "new ecology" arising from coastal modification is useful, broad conclusions around the ecological role or conservation gains from seawall construction without adequate contextualization underplays the ecological consequences of large-scale coastal land claim, and could potentially undermine efforts to achieve biodiversity conservation. Here, we clarify the characteristics of seawall construction in China and summarize the environmental damage and some broadscale impacts caused by this type of infrastructure expansion on the endangered Yellow Sea tidal flats ecosystem. We also highlight the urgent need for all coastal development plans to consider how coastal wetlands and ecosystem functionality can be maximally retained within the development precinct.

Yang, W., Li, N., Leng, X., Qiao, Y., Cheng, X., & An, S. 2016. **The impact of sea embankment reclamation on soil organic carbon and nitrogen pools in invasive Spartina alterniflora and native Suaeda salsa salt marshes in eastern China**. Ecological Engineering, 97 (Supplement C), 582–592. https://doi.org/10.1016/j.ecoleng.2016.10.064

(Abstract)

The construction of sea embankments is an increasingly common approach for controlling the spread of the exotic C_4 perennial grass *Spartina alterniflora* Loisel. in coastal wetlands of eastern China. However, the impact of sea embankment reclamation on the soil organic carbon (C) and nitrogen (N) dynamics in salt marshes is not fully understood. In this study, we examined the stocks of the total, labile and recalcitrant organic C and N, the recalcitrant indices of C and N, and the concentrations of water-soluble organic carbon (WSOC), microbial biomass carbon (MBC) and cumulative CO_2-C mineralization (MINC) in sea embankment-reclaimed *S. alterniflora* and *Suaeda* salsa (Linn.) Pall. salt marshes through comparisons with adjacent unreclaimed *S. alterniflora* and *S. salsa* salt marshes in a coastal wetland of

eastern China. Sea embankment reclamation significantly decreased plant biomass by 55.34%, soil salinity by 81.71%, soil moisture by 43.16%, soil total organic C by 50.60% and total organic N by 49.99%, and also lowered labile and recalcitrant organic C and N, WSOC, MBC and MINC in the invasive *S. alterniflora* salt marsh. However, sea embankment reclamation did not significantly affect the stocks of the soil organic total C and N, recalcitrant organic C and N, and soil organic C dynamics in the native *S. salsa* salt marsh, possibly because the total quantity of *S. salsa* materials entering the soil, soil salinity, moisture and bulk density were not affected by sea embankment reclamation. Our results suggest that the impact of sea embankment reclamation on soil organic C and N pools is much more profound in *S. alterniflora* salt marsh than in *S. salsa* salt marsh. Sea embankment reclamation could greatly weaken the C and N sinks of *S. alterniflora* salt marsh and potentially affect C and N sinks in the coastal wetlands of eastern China.

Yang, W., An, S., Zhao, H., Xu, L., Qiao, Y., & Cheng, X. 2016. Impacts of *Spartina alterniflora* invasion on soil organic carbon and nitrogen pools sizes, stability, and turnover in a coastal salt marsh of eastern China. Ecological Engineering, 86 (Supplement C), 174–182. https://doi.org/https://doi.org/10.1016/j.ecoleng.2015.11.010

(Abstract)

Plant invasion may impact ecosystem structure and function, and further affect soil organic matter (SOM) dynamics. However, the influence of plant invasion on soil organic carbon (C) and nitrogen (N) pools sizes, stability, and turnover in SOM of invaded ecosystems is not fully understood. In this study, soil C and N contents, and $\delta^{13}C$ and $\delta^{15}N$ values of free light fraction (LF), intra-aggregate particulate organic matter (iPOM) and mineral-associated organic matter (mSOM) were investigated in an invasive *Spartina alterniflora* community, adjacent bare flat and native *Suaeda salsa* and *Phragmites australis* communities. Short-term *S. alterniflora* invasion significantly enhanced organic C and N contents in SOM, free LF, iPOM, mSOM compared with bare flat and increased the proportion of allocated C in iPOM compared with *S. salsa* and *P. australis* soils (0–0.30 m depth). The proportion of the *S. alterniflora*-derived C in free LF and iPOM were significantly higher than that in mSOM, and the highest *S. alterniflora*-derived C content was found in iPOM of *S. alterniflora* soil. The most enriched $\delta^{15}N$ values were found in *S. alterniflora* soil. Increased $\delta^{15}N$ values and decreased C:N ratios from the free LF to iPOM to mSOM in *S. alterniflora* soil indicated a greater degree of decomposition. The results suggest that 10-year *S. alterniflora* invasion significantly alters soil organic C and N pools sizes and stability through changing plant residuals input, physical distribution of *S. alterniflora*-derived C and C turnover in SOM fractions.

Murray, N. J., Marra, P. P., Fuller, R. A., Clemens, R. S., Dhanjal-Adams, K., Gosbell, K. B., Hassell, C. J., Iwamura, T., Melville, D., Minton, C. D. T., Riegen, A. C., Rogers, D. I., Woehler, E. J. and Studds, C. E. 2017, The large-scale drivers of population declines in a long-distance migratory shorebird. Ecography. Accepted Author Manuscript. doi:10.1111/ecog.02957

(Abstract)

Migratory species can travel tens of thousands of kilometers each year, spending different parts of their annual cycle in geographically distinct locations. Understanding the drivers of population change is vital for conserving migratory species, yet the challenge of collecting data over entire geographic ranges has hindered attempts to identify the processes leading to observed population changes. Here, we use remotely sensed environmental data and count data to investigate the factors driving variability in abundance in two subspecies of a long-distance migratory shorebird, the bar-tailed godwit (*Limosa lapponica*). We compiled a spatially and temporally explicit dataset of three environmental variables to identify the conditions experienced by each subspecies in each stage of their annual cycle (breeding, non-breeding and staging). We used a Bayesian *N*-mixture model to analyze 18 years of monthly count data from 21 sites across Australia and New Zealand in relation to the remote sensing datasets. We found that the abundance of one subspecies (*L. l. menzbieri*) in their non-breeding range was related to climate conditions in breeding grounds, and detected sustained population declines between 1995 and 2012 in both subspecies (*L. l. menzbieri,* -6.7% and *L. l. baueri,* -2.1% $year^{-1}$). To investigate the possible causes of the declines, we quantified changes in habitat extent at 22 migratory staging sites in the Yellow Sea, East Asia, over a 25-year period and found -1.7% and -1.2% $year^{-1}$ loss of habitat at staging sites used by *L. l. menzbieri* and *L. l baueri*, respectively. Our results highlight the need to identify environmental and anthropogenic drivers of population change across all stages of migration to allow the formulation of effective conservation strategies across entire migratory ranges.

Rodriguez, Jose & M. Saco, Patricia & Sandi, Steven & Saintilan, Neil & Riccardi, Gerardo. 2017. Potential increase in coastal wetland vulnerability to sea-level rise suggested by considering hydrodynamic attenuation effects. Nature Communications. 8. 16094. 10.1038/ncomms16094.

(Abstract)

The future of coastal wetlands and their ecological value depend on their capacity to adapt to the interacting effects of human impacts and sea-level rise. Even though extensive wetland loss due to submergence is a possible scenario, its magnitude is highly uncertain due to limited understanding of hydrodynamic and bio-geomorphic interactions over time. In particular, the effect of man-made drainage modifications on hydrodynamic attenuation and consequent wetland evolution is poorly understood. Predictions are further complicated by the presence of a number of vegetation types that change over time and also contribute to flow attenuation. Here, we show that flow attenuation affects wetland vegetation by modifying its wetting-drying regime and inundation depth, increasing its vulnerability to sea-level rise. Our simulations for

an Australian subtropical wetland predict much faster wetland loss than commonly used models that do not consider flow attenuation.

PENG, HE-BO, GUY Q. A. ANDERSON, QING CHANG, CHI-YEUNG CHOI, SAYAM U. CHOWDHURY, NIGEL A. CLARK, XIAOJING GAN, et al. 2017. The Intertidal Wetlands of Southern Jiangsu Province, China – Globally Important for Spoon-Billed Sandpipers and Other Threatened Waterbirds, but Facing Multiple Serious Threats. *Bird Conservation International*, 2017, 1–18. doi:10.1017/S0959270917000223.

(Abstract)

The Yellow Sea region is of high global importance for waterbird populations, but recent systematic bird count data enabling identification of the most important sites are relatively sparse for some areas. Surveys of waterbirds at three sites on the coast of southern Jiangsu Province, China, in 2014 and 2015 produced peak counts of international importance for 24 species, including seven globally threatened and six Near Threatened species. The area is of particular global importance for the 'Critically Endangered' Spoon-billed Sandpiper Calidris pygmaea (peak count across all three study sites: 62 in spring [2015] and 225 in autumn [2014] and 'Endangered' Spotted Greenshank Tringa guttifer (peak count across all three study sites: 210 in spring [2014] and 1,110 in autumn [2015]). The southern Jiangsu coast is therefore currently the most important migratory stopover area in the world, in both spring and autumn, for both species. Several serious and acute threats to waterbirds were recorded at these study sites. Paramount is the threat of large-scale land claim which would completely destroy intertidal mudflats of critical importance to waterbirds. Degradation of intertidal mudflat habitats through the spread of invasive Spartina, and mortality of waterbirds by entrapment in nets or deliberate poisoning are also real and present serious threats here. Collisions with, and displacement by, wind turbines and other structures, and industrial chemical pollution may represent additional potential threats. We recommend the rapid establishment of effective protected areas for waterbirds in the study area, maintaining large areas of open intertidal mudflat, and the urgent removal of all serious threats currently faced by waterbirds here.

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Collop, C., R. A. Stillman, A. Garbutt, M. G. Yates, E. Rispin, and T. Yates. 2016. Variability in the area, energy and time costs of wintering waders responding to disturbance. *Ibis* **158**:711–725.

(Abstract)

Birds' responses to human disturbance are interesting due to their similarities to antipredator behaviour, and understanding this behaviour has practical applications for conservation management by informing measures such as buffer zones to protect priority species. To understand better the costs of disturbance and whether it will impact on population size, studies should quantify time-related responses as well as the more commonly reported flight initiation distance (FID). Using waders wintering on an estuarine area, we experimentally disturbed foraging birds on the Wash Embayment, UK, by walking towards them and recording their responses (FID, alert time, time spent in flight, time taken to resume feeding, and total feeding time lost). We present data for 10 species of conservation concern: Curlew *Numenius arquata*, Oystercatcher *Haematopus ostralegus*, Bar-tailed Godwit *Limosa lapponica*, Grey Plover *Pluvialis squatarola*, Redshank *Tringa totanus*, Knot *Calidris canutus*, Turnstone *Arenaria interpres*, Ringed Plover *Charadrius hiaticula*, Sanderling *Calidris alba* and Dunlin *Calidris alpina*. Larger species responded more strongly, response magnitude was greater under milder environmental conditions, and responses varied over both small and large spatial scales. The energetic costs of individual responses, however, were low relative to daily requirements and disturbance events were unlikely to be frequent enough to seriously limit foraging time. We suggest, therefore, that wintering wader populations on the Wash are not currently significantly negatively impacted by human disturbance during the intertidal foraging period. This is also likely to be the case at other estuarine sites with comparable access levels, visitor patterns, invertebrate food availability and environmental conditions.

Saalfeld, D. T., A. C. Matz, B. J. McCaffery, O. W. Johnson, P. L. Bruner, and R. B. Lanctot. 2016. Inorganic and organic contaminants in Alaskan shorebird eggs. *Environmental Monitoring and Assessment* **188**:276.

(Abstract)

Many shorebird populations throughout North America are thought to be declining, with potential causes attributed to habitat loss and fragmentation, reduced prey availability, increased predation, human disturbance, and increased exposure to environmental pollutants. Shorebirds may be particularly vulnerable to contaminant exposure throughout their life cycle, as they forage primarily on invertebrates in wetlands, where many contaminants accumulate disproportionately in the sediments. Therefore, it is important to document and monitor shorebird populations thought to be at risk and assess the role that environmental contaminants may have on population declines. To investigate potential threats and provide baseline data on shorebird contaminant levels in Alaskan shorebirds, contaminant concentrations were evaluated in shorebird eggs from 16 species residing in seven geographic distinct regions of Alaska. Similar to previous studies, low levels of most inorganic and organic contaminants were found, although concentrations of several inorganic and organic contaminants were higher than those of previous studies. For example, elevated strontium levels were observed in several species, especially black oystercatcher (*Haematopus bachmani*) sampled in Prince William Sound, Alaska. Additionally, contaminant concentrations varied among species, with significantly higher concentrations of inorganic contaminants

found in eggs of pectoral sandpiper (*Calidris melanotos*), semipalmated sandpiper (*Calidris pusilla*), black oystercatcher, and bar-tailed godwit (*Limosa lapponica*). Similarly, significantly higher concentrations of some organic contaminants were found in the eggs of American golden plover (*Pluvialis dominica*), black-bellied plover (*Pluvialis squatarola*), pacific golden plover (*Pluvialis fulva*), bar-tailed godwit, and semipalmated sandpiper. Despite these elevated levels, current concentrations of contaminants in shorebird eggs suggest that breeding environments are relatively free of most contaminants and that contaminant concentrations are below levels (except potentially strontium) that would likely affect the survival of individuals and consequently regulate the species at the population level.

Luo, J., Y. Ye, Z. Gao, W. Wang, and B. K. Hartup. 2016. Lead in the Red-Crowned Cranes (*Grus japonensis*) in Zhalong Wetland, Northeastern China: A Report. *Bulletin of Environmental Contamination and Toxicology* **97**:177–183.

(Abstract)

The dietary uptake of Cd and Pb may contribute to the decline of migratory red-crowned cranes (*Grus japonensis*) on the Asian mainland. To uncover the relevance of this hypothesis, we determined the concentrations of Pb and Cd as well as further macro and trace elements (Ca, Mg, Cu, Zn, Hg and As) in the gastric contents, gastric wall, intestinal wall, liver, kidney, muscle, and feathers of two individuals found dead in Zhalong Wetland in Northeastern China. Indeed, the Pb concentrations in the liver and kidney tissues was with 31.4 and 60.3 mg/kg dry weight (dw), respectively, above concentrations considered as potentially toxic level in common birds (i.e. 30 mg/kg). These Pb concentration may have possibly been associated with lethal toxicosis in this endangered species suggesting Pb as major threat for *G. japonensis* populations. Thus, the inputs of Pb into Zhalong Wetland should be reduced to maintain and reestablish environmental conditions supporting the population development of these migratory red-crowned cranes in the Zhalong Wetland, a critical crane habitat for the long-term sustainability of this species.

Perkins, M., L. Ferguson, R. B. Lanctot, I. J. Stenhouse, S. Kendall, S. Brown, H. R. Gates, J. O. Hall, K. Regan, and D. C. Evers. 2016. Mercury exposure and risk in breeding and staging Alaskan shorebirds. *The Condor* **118**:571–582.

(Abstract)

Mercury contamination has become a major concern in the Arctic, where elevated mercury deposition has led to large increases in mercury exposure for some Arctic wildlife over the past century. Chronic mercury exposure in birds is known to reduce reproductive success, which may ultimately result in population declines. Many species of Arctic-breeding shorebirds

are declining, and exposure to environmental contaminants, such as mercury, may be an important factor. We quantified mercury exposure in 10 shorebird species breeding and staging in Alaska. We analyzed 229 blood and 73 feather samples collected in 2008–2009 for total mercury concentrations. Mercury in blood represents local exposure, whereas mercury in feathers reflects exposure during feather development. Concentrations of mercury ranged from 0.03 to 2.20 ug/g in shorebird blood and from 0.16 to 3.66 ug/g in shorebird feathers. Most shorebirds sampled during staging had relatively low blood mercury, but some breeding species had sufficiently high concentrations for potential adverse effects. Overall, blood mercury concentrations of breeding shorebirds differed by moisture content of their predominant foraging habitat, with the highest concentrations found in species using wet to aquatic habitats. We also found variation in mercury concentrations by age class and sex for some species, with females showing lower concentrations than males, but we found no relationship between the amount of mercury in feathers and in blood. The degree of mercury exposure seen in Arctic-breeding shorebirds may be of particular concern when combined with other ecological stressors, such as habitat loss, predation, disturbance, and climate change.

Bernik, B. M., H. Li, and M. J. Blum. 2016. Genetic variation of *Spartina alterniflora* intentionally introduced to China. *Biological Invasions* **18**:1485–1498.

(Abstract)

Spread of smooth cordgrass (*Spartina alterniflora*) in China is an exceptional example of unanticipated outcomes arising from intentional introductions. It has been proposed that in China, management strategies used to establish *S. alterniflora* inadvertently promoted evolutionary outcomes that have contributed to other Spartina invasions. In this study, we assessed whether *S. alterniflora* in China exhibits genetic signatures of mechanisms known to promote invasion success, including large founding populations, evolved self-fertility, 'superior source ecotypes', and post-introduction admixture. This involved comparing microsatellite genotype and chloroplast haplotype variation among Chinese populations to other invasive *S. alterniflora* populations as well as native range populations, inclusive of samples from all reported source areas. We found distinct signatures of source population contributions to Chinese populations, as well as evidence of post-introduction admixture, and no evidence of limitations from a genetic bottleneck. Measures of inbreeding were well below what has been found in other non-native populations that have evolved self-fertility. Differences in genetic diversity among sites were similar to latitudinal patterns in the native range, but could be attributable to introduction history. Comparisons to other invasive populations indicate that a combination of common and idiosyncratic processes have contributed to the success of *S. alterniflora* in China and elsewhere, with intentional introductions promoting mechanisms that accelerate rates of spread and widespread invasion.

Tsygankov, V. Y., M. D. Boyarova, and O. N. Lukyanova. 2016. Bioaccumulation of organochlorine pesticides (OCPs) in the northern fulmar (*Fulmarus glacialis*) from the Sea of Okhotsk. *Marine Pollution Bulletin* **110**:82–85.

(Abstract)

Hexachlorocyclohexane (HCH) isomers (α-, β-, and γ-), DDT and its metabolites (DDD and DDE) were detected in five individuals of Northern fulmar *Fulmarus glacialis Linnaeus*, 1761 from the Sea of Okhotsk. The average amount of HCHs in the organs of fulmars ranged from 608±177 ng/g lipids in the total homogenate of the organs to 2093±264 ng/g lipids in the feathers with skin. The average range of the amounts of DDTs was from 3606±333 ng/g lipids in the feathers with skin to 4076±1624 ng/g lipids in the feathers. The bioaccumulation of DDTs by seabirds of the Sea of Okhotsk is approximately equal to that of birds from other regions of the world's oceans, while the HCHs concentration is significantly higher.

Troisi, G., S. Barton, and S. Bexton. 2016. Impacts of oil spills on seabirds: Unsustainable impacts of non-renewable energy. *International Journal of Hydrogen Energy* **41**:16549-16555.

(Abstract)

Accidental spillage of oil in to the sea from shipping transport and drilling rigs results in spills that cause significant unsustainable mortality of wildlife and destroys marine ecosystem services. External oiling of seabirds causes large scale mortality within days following a spill, while survivors suffer causes long term chronic effects from the exposure to toxic polycyclic aromatic hydrocarbons (PAHs) present in ingested oil. Survival rates for rehabilitated oiled birds are very low despite investment of significant resources. PAHs disturb thyroid homeostasis which plays a vital role in the control of energy metabolism. In this study, plasma PAH and thyroid-stimulating hormone (TSH) were quantified as biomarkers of exposure and endocrine disruption in oiled guillemots (*Uria aalge*). Mean plasma PAH and TSH concentrations, were 98.1 ± 8.3 ng/ml and 0.13 ± 0.02 ng/ml and these parameters were found to be negatively correlated ($p < 0.01$) indicative of PAH-associated thyroid hormone suppression in more heavily oiled birds. Body condition and weight were also lower in birds that died compared with birds that were released. The data also show the value of measuring plasma TSH and PAH to monitor metabolic status and progress of decontamination of oiled birds in a rehabilitation setting.

Soares, L., G. Escudero, V. A. S. Penha, and R. E. Ricklefs. 2016. Low Prevalence of Haemosporidian Parasites in Shorebirds. *Ardea* **104**:129-141.

(Abstract)

Although shorebirds (*Charadriiformes*: suborders *Scolopaci* and *Charadrii*) face physiological stress during migration and experience a wide range of vector-suitable habitats across their distributions, haemosporidian parasites (order *Haemosporida*) have rarely been detected in these species worldwide. We ask whether shorebirds remain infection-free when wintering in areas where parasite transmission occurs among landbird species. Blood samples were collected at three locations in Argentina: Patagonia, with an avian assemblage dominated by shorebird species; Mar Chiquita Lagoon, a high-salinity water basin where shorebird and landbird species co-occur; and inland sites in Chaco and Cordoba provinces, where host assemblages included mostly landbird species. We screened 650 samples for the presence of haemosporidian infections and sequenced a part of the parasite mitochondrial cytochrome b gene to determine parasite lineages. Of 342 landbirds, 91 were infected with haemosporidian parasites, compared to only three of 318 shorebirds. Wintering location had no effect on the prevalence of haemosporidian parasites in shorebirds. Haemosporidian infections are rare in shorebirds even when these co-occur with landbird species in inland areas suitable for parasite transmission. The few infections detected in shorebirds might represent spillover infections from landbirds, as the parasite lineages were also found in common landbird species. We suggest that shorebirds are resistant to haemosporidian parasites, and either do not become infected or quickly clear occasional infections.

Minias, P., R. Włodarczyk, and T. Janiszewski. 2016. Minor differentiation of foraging niche may have a major impact on the incidence of avian botulism in shorebirds. *Basic and Applied Ecology* **17**:546–551.

(Abstract)

Avian botulism is a fatal disease of birds caused by ingestion of neurotoxins produced by Clostridium botulinum type C and is now recognized as the most common cause of death in waterbirds worldwide. Although tens of species have been reported to suffer from avian botulism, it remains unknown which ecological factors primarily determine inter-specific variation in the incidence of this disease. We hypothesized that an exposure of birds to botulin may largely depend on their foraging niche, as the toxin is available mostly at the sediment surface, especially during the carcass-maggot stage of botulism epizootics. To test this hypothesis we used capture-recapture methods to estimate mortality of two shorebird species differing in bill morphology and foraging niche, wood sandpiper *Tringa glareola*(short bill, surface-feeding) and common snipe *Gallinago gallinago* (long bill, deep probing), during a major avian type C botulism outbreak in central Poland. All the reported cases of shorebird mortality were attributed to botulism and we found large differences in daily survival rates of both species (0.87 and 0.99 in wood sandpipers and common snipe, respectively). Even assuming much shorter stopover duration of wood sandpipers, survival rate over the entire stopover period was estimated at 0.57 in the wood sandpiper and at 0.90 in the common snipe. To our knowledge, this is the first non-circumstantial evidence that relatively minor differentiation of foraging niche may have a major impact on the incidence of avian botulism

in birds. Our data might also suggest that, on the evolutionary time scale, avian type C botulism may constitute a strong selective pressure acting on foraging niches of shorebirds, and possibly other waterbirds.

Dierschke, V., R. W. Furness, and S. Garthe. 2016. Seabirds and offshore wind farms in European waters: Avoidance and attraction. *Biological Conservation* **202**:59–68.

(Abstract)

The extent to which seabirds are displaced from, or attracted to, offshore wind farms (OWFs) is uncertain, but rapid development of OWFs in European waters could conflict with seabird conservation. We review post-construction studies of seabirds at 20 OWFs in European waters to extract and classify evidence for displacement or attraction of 33 different seabird species. Divers and northern gannets showed consistent and strong avoidance behaviour/displacement, and this may also be the case for great crested grebe and northern fulmar. Long-tailed duck, common scoter, Manx shearwater, razorbill, common guillemot, little gull and sandwich tern showed less consistent displacement from OWFs. Several gull species and red-breasted merganser showed weak attraction, while great cormorant and European shag showed strong attraction to OWFs. Other species show little response. Displacement seems mainly to be due to bird responses to OWF structures and appears stronger when turbines are rotating, but could in part be due to boat traffic to and from OWFs. Attraction of cormorants relates at least in part to their use of structures for roosting and for drying plumage, but increases in food availability at OWFs appears to be an important influence for several species.

Garcia, C., R. A. Stillman, R. M. Forster, T. Silva, and J. Bremner. 2016. Nuclear power and coastal birds: Predicting the ecological consequences of warm-water outflows. *Ecological Modelling* **342**:60–81.

(Abstract)

Local alteration of species abundance in natural communities due to anthropogenic impacts may have secondary, cascading effects on species at higher trophic levels. Such effects are typically hard to single out due to their ubiquitous nature and, therefore, may render impact assessment exercises difficult to undertake. Here we describe how we used empirical knowledge together with modelling tools to predict the indirect trophic effects of a future warm-water outflow on populations of shorebirds and wildfowl. Of the main potential benthic prey used by the birds in this instance, the clam *Macoma balthica* was the only species suspected to be adversely affected by a future increase of temperature. Various scenarios of decreases in prey energy content, simulating various degrees of temperature increase, were tested using

an individual-based model, MORPH, in order to assess the effects on birds. The survival and body condition of eight of the 10 bird species modelled, dunlin, ringed plover, turnstone, redshank, grey plover, black-tailed godwit, oystercatcher and shelduck were shown to be not influenced even by the most conservative prey reduction scenarios. Most of these species are known to feed primarily on polychaete worms. For the few bivalve-feeding species, the larger size-classes of polychaete worms were predicted to be a sufficient alternative food. Only knot was predicted to have a lower survival under the two worst case scenario of decreased *M. balthica* energy content. We believe that this is the first time such predicted cascade effects from a future warm-water outflow have been shown.

Green, R. E., and D. J. Pain. 2016. Possible effects of ingested lead gunshot on populations of ducks wintering in the UK. *Ibis* **158**:699–710.

(Abstract)

Although the use of lead ammunition for shooting wildfowl and/or over listed wetlands in the UK has been banned, c. 70% of ducks shot in England (the only UK country with compliance monitoring) are still shot with lead and the proportion of ducks found dead with signs of lead poisoning from ingested gunshot has not declined significantly since the ban. However, there is little quantitative evidence of the impacts of additional mortality from lead poisoning on duck populations. For the eight duck species that winter in freshwater habitats in the UK, we found that inter-specific variation in mean population growth rate during the period 1990/1991 to 2013/2014 was significantly negatively correlated with two independent measures of the prevalence of ingested lead gunshot in the UK and Europe. This relationship was found for a wide range of different periods over which population growth was estimated, and also for annual growth rates in the period 1966/1967 to 2013/2014, derived from smoothed population trajectories. These findings support the hypothesis that ingested lead gunshot might affect population trend. An alternative hypothesis, that migratory short-stopping driven by climate change affected trends in numbers of ducks wintering in the UK, was not supported by simple or partial correlation results. The possible impact of ingested lead gunshot on the Common Pochard *Aythya ferina*, a species listed as globally threatened, is of special concern.

Liang, J., J. Liu, X. Yuan, G. Zeng, Y. Yuan, H. Wu, and F. Li. 2016. A method for heavy metal exposure risk assessment to migratory herbivorous birds and identification of priority pollutants/areas in wetlands. *Environmental Science and Pollution Research* **23**:11806–11813.

(Abstract)

Wetlands are important habitats for migratory birds but have been degraded by many anthropogenic factors including heavy metal contamination. Birds inhabiting wetlands are exposed to pollutants. In this study, a method for exposure risk assessment of migratory herbivorous birds and identification of priority pollutants/areas was developed and employed in East Dongting Lake wetland (EDT). Four heavy metals (Cr, Cu, Pb, and Cd) in sedge and soil samples from ten lesser white-fronted goose (*Anser erythropus*) habitats in EDT were investigated. Results showed that negative effect of Cr and Pb on lesser white-fronted goose may occur while the concentrations of Cu and Cd are considered to be relatively safe. Prioritize threats were decreased in the following sequence: Cr > Pb > Cu > Cd. Cr and Pb were considered to be the priority pollutants. Spatial interpolation based on geostatistical methods showed that Spring Breeze Lake should draw much attention. Furthermore, regions with high hazard index were identified to be priority areas of EDT for risk management.

Watanuki, Y., A. Yamashita, M. Ishizuka, Y. Ikenaka, S. M. M. Nakayama, C. Ishii, T. Yamamoto, M. Ito, T. Kuwae, and P. N. Trathan. 2016. Feather mercury concentration in streaked shearwaters wintering in separate areas of southeast Asia. *Marine Ecology Progress Series* **546**:263–269.

(Abstract)

We measured mercury concentration ([Hg]) and nitrogen stable isotope values (δ15N) in tail feathers that were replaced during the non-breeding period of streaked shearwaters *Calonectris leucomelas* that bred on 3 islands in Japan. The birds' year-round movements were tracked and their breeding status was monitored. [Hg] was greater in males than in females, and was greatest in those birds spending their non-breeding period in the South China Sea (3.1±1.5 μg/g dry weight), moderate in birds in the Arafura Sea (1.5±0.7 μg/g), and lowest in birds in the Pacific Ocean north of New Guinea (0.8±0.4 μg/g). Adverse effects of feather [Hg] on breeding status were not observed. This regional variation in feather [Hg] might partly reflect differences in the intake of Hg between these non-breeding areas in addition to accumulation during the late breeding period and the southward migration period.

Tantipisanuh, N., G. A. Gale, and P. D. Round. 2016. Incidental impacts from major road construction on one of Asia's most important wetlands: the Inner Gulf of Thailand. *Pacific Conservation Biology* **22**:29–36.

(Abstract)

Large-scale infrastructure development projects can have devastating impacts upon biodiversity. We investigated the impacts of roads on land-use change in a coastal area of South-east Asia, an area of high biodiversity subject to intense human pressure. The

objectives of this study were (1) to examine impacts of major roads on rates of landuse change and habitat conversion in and around the Inner Gulf of Thailand, a large wetland of international importance; and (2) to evaluate the conversion rate of salt-pans (a critical habitat for several species of threatened shorebirds) between 1990 and 2011. Nine land-use types were categorised into two groups: seminatural and human-dominated. Proportions of each land-use type at different distances from major roads were determined using GIS data. More than 40% of the area was used for aquaculture during the entire study period. The amount of seminatural habitats was positively correlated with distance from major roads. Agriculture and urban areas showed the greatest changes in area (decreasing and increasing, respectively). Habitats that changed from seminatural to human-dominated were negatively correlated with distance from major roads. Most of the converted salt-pans were lost to aquaculture. To protect important wetlands from further biodiversity loss: (1) new major road construction should be avoided or minimised; and (2) land-use strategies that both satisfy short-term human needs and maintain ecosystem capacity to provide services in the long term should be adopted.

Braune, B. M., A. J. Gaston, and M. L. Mallory. 2016. Temporal trends of mercury in eggs of five sympatrically breeding seabird species in the Canadian Arctic. *Environmental Pollution***214**:124-131.

(Abstract)

We compared temporal trends of total mercury (Hg) in eggs of five seabird species breeding at Prince Leopold Island in the Canadian high Arctic. As changes in trophic position over time have the potential to influence contaminant temporal trends, Hg concentrations were adjusted for trophic position (measured as d15N). Adjusted Hg concentrations in eggs of thick-billed murres (*Uria lomvia*) and northern fulmars (*Fulmarus glacialis*) increased from 1975 to the 1990s, followed by a plateauing of levels from the 1990s to 2014. Trends of adjusted Hg concentrations in eggs of murres, fulmars, black guillemots (*Cepphus grille*) and black-legged kittiwakes (*Rissa tridactyla*) had negative slopes between 1993 and 2013. Adjusted Hg concentrations in glaucous gull (*Larus hyperboreus*) eggs decreased by 50% from 1993 to 2003 before starting to increase again. Glaucous gull eggs had the highest Hg concentrations followed by black guillemot eggs, and black-legged kittiwake eggs had the lowest concentrations consistently in the five years compared between 1993 and 2013. Based on published toxicological thresholds for Hg in eggs, there is little concern for adverse reproductive effects due to Hg exposure in these birds, although the levels in glaucous gull eggs warrant future scrutiny given the increase in Hg concentrations observed in recent years. There is evidence that the Hg trends observed reflect changing anthropogenic Hg emissions. It remains unclear, however, to what extent exposure to Hg on the overwintering grounds influences the Hg trends observed in the seabird eggs at Prince Leopold Island. Future research should focus on determining the extent to which Hg exposure on the breeding grounds versus the overwintering areas contribute to the trends observed in the eggs.

La Sorte, F. A., W. M. Hochachka, A. Farnsworth, A. A. Dhondt, and D. Sheldon. 2016. The implications of mid-latitude climate extremes for North American migratory bird populations. *Ecosphere* **7**:e01261.

(Abstract)

Mid-latitude climate extremes are projected to increase in frequency under global climate change. How this may affect migratory bird populations is not well understood. The mid-latitudes of North America experienced an extreme warming event during March 2012 that advanced the spring phenology of ecological productivity, resulting in lower levels of productivity during the summer. Here, we test the predictions that: (1) short-distance migratory birds, due to geographic proximity and more flexible migratory behavior, should advance their spring migration phenology; and (2) breeding populations, due to lower summer productivity, should have reduced occurrences. We used occurrence data for 353 bird species from the eBird database to calculate weekly occurrence anomalies for 2012 relative to the 2010–2014 average. We identified species having unusually large positive occurrence anomalies during March 2012 and species having unusually large negative occurrence anomalies during July–August 2012. For each category, we summarized migration strategies, geographic distributions, and annual associations with temperature and ecological productivity. Short-distance migrants whose winter and breeding ranges intersect the mid-latitudes advanced their spring migration phenology during March (n = 21). Long-distance migrants whose winter and breeding distributions were weakly associated with the mid-latitudes had lower occurrences during the summer (n = 32). Five species were shared between the two categories. Within species' winter ranges, temperature and ecological productivity were higher than expected during March; within species' breeding ranges, ecological productivity was lower than expected during the summer. These differences were strongest for the 21 short-distance migrants. Following our expectations, mid-latitude climate extremes and associated ecological consequences broadly affected avian migration and breeding activities within the region. Our findings suggest short-distance migrants are more flexible and resilient, whereas populations of long-distance migrants are at a distinct disadvantage, which may intensify if the frequency of these events increases.

Graff, B. J., J. A. Jenks, J. D. Stafford, K. C. Jensen, and T. W. Grovenburg. 2016. Assessing Spring Direct Mortality to Avifauna from Wind Energy Facilities in the Dakotas. *The Journal of Wildlife Management* **80**:736–745.

(Abstract)

The Northern Great Plains (NGP) contains much of the remaining temperate grasslands, an ecosystem that is one of the most converted and least protected in the world. Within the NGP, the Prairie Pothole Region (PPR) provides important habitat for >50% of North America's

breeding waterfowl and many species of shorebirds, waterbirds, and grassland songbirds. This region also has high wind energy potential, but the effects of wind energy developments on migratory and resident bird and bat populations in the NGP remains understudied. This is troubling considering >2,200 wind turbines are actively generating power in the region and numerous wind energy projects have been proposed for development in the future. Our objectives were to estimate avian and bat fatality rates for wind turbines situated in cropland- and grassland-dominated landscapes, document species at high risk to direct mortality, and assess the influence of habitat variables on waterfowl mortality at 2 wind farms in the NGP. From 10 March to 7 June 2013–2014, we completed 2,398 searches around turbines for carcasses at the Tatanka Wind Farm (TAWF) and the Edgeley-Kulm Wind Farm (EKWF) in South Dakota and North Dakota. During spring, we found 92 turbine-related mortalities comprising 33 species and documented a greater diversity of species (n=30) killed at TAWF (predominately grassland) than at EKWF (n=9; predominately agricultural fields). After accounting for detection rates, we estimated spring mortality of 1.86 (SE=0.22) deaths/megawatt (MW) at TAWF and 2.55 (SE=0.51) deaths/MW at EKWF. Waterfowl spring (Mar–Jun) fatality rates were 0.79 (SE=0.11) and 0.91 (SE=0.10) deaths/MW at TAWF and EKWF, respectively. Our results suggest that future wind facility siting decisions consider avoiding grassland habitats and locate turbines in preexisting fragmented and converted habitat outside of high densities of breeding waterfowl and major migration corridors.

Fu, Q., N. Wang, M. Shen, N. Song, and H. Yan. 2016. A study of the site selection of a civil airport based on the risk of bird strikes: The case of Dalian, China. *Journal of Air Transport Management* **54**:17-30.

(Abstract)

Bird strikes are a potential danger to aviation security. The threat of birds to the flight security of civil airplanes is hard to solve if the existence of birds in nature is ignored. An in-depth study on the living habits of birds and the request for a harmonious coexistence between birds and civil airplanes seems to be an effective way to relieve this contradiction. Taking the case of the site selection of the civil airport in Dalian of China, this paper comprehensively analysed the bird strike assessment of various species of birds near the sites of Zhoushuizi Airport and Jinzhou Bay Airport. The assessment of the risk of bird strikes demonstrated that the site of the Jinzhou Bay airport would have a smaller risk of bird strikes, which could greatly reduce collisions between birds and airplanes and promote aviation security. Such results provide a valuable reference for the site selection of the civil airport in Dalian. As bird strikes are a common problem in the field of civil aviation, the analysis and methods in this paper are a needed reference for the planning and land use of civil airports in other cities.

Brochet A-L, Van Den Bossche W, Jbour S, Ndang'ang'a K, Jones VR, Abdou WALI, Al-Hmoud AR, Asswad NG, Atienza JC, Atrash I, Barbara N, Bensusan K, Bino T, Celada C, Cherkaoui SI, Costa J, Deceuninck B, Etayeb KS, Feltrup-Azafzaf C, Figelj J, Gustin M, Kmecl P, Kocevski V, Korbeti M, Kotrošan D, Laguna JM, Lattuada M, Leitão D, Lopes P, López-Jiménez N, Lucić V, Micol T, Moali A, Perlman Y, Piludu N, Portolou D, Putilin K, Quaintenne G, Ramadan-Jaradi G, Ružić M, Sandor A, Sarajli N, Saveljić D, Sheldon RD, Shialis T, Tsiopelas N, Vargas F, Thompson C, Brunner A, Grimmett R, Butchart SHM. 2016. Preliminary assessment of the scope and scale of illegal killing and taking of birds in the Mediterranean. *Bird Conservation International* **26** (1):1-28.

(Abstract)

Illegal killing/taking of birds is a growing concern across the Mediterranean. However, there are few quantitative data on the species and countries involved. We assessed numbers of individual birds of each species killed/taken illegally in each Mediterranean country per year, using a diverse range of data sources and incorporating expert knowledge. We estimated that 11–36 million individuals per year may be killed/taken illegally in the region, many of them on migration. In each of Cyprus, Egypt, Italy, Lebanon and Syria, more than two million birds may be killed/taken on average each year. For species such as Blackcap *Sylvia atricapilla* , Common Quail *Coturnix coturnix* , Eurasian Chaffinch *Fringilla coelebs* , House Sparrow *Passer domesticus* and Song Thrush *Turdus philomelos*, more than one million individuals of each species are estimated to be killed/taken illegally on average every year. Several species of global conservation concern are also reported to be killed/taken illegally in substantial numbers: Eurasian Curlew *Numenius arquata*, Ferruginous Duck *Aythya nyroca* and Rock Partridge *Alectoris graeca*. Birds in the Mediterranean are illegally killed/taken primarily for food, sport and for use as cage-birds or decoys. At the 20 worst locations with the highest reported numbers, 7.9 million individuals may be illegally killed/taken per year, representing 34% of the mean estimated annual regional total number of birds illegally killed/taken for all species combined. Our study highlighted the paucity of data on illegal killing/taking of birds. Monitoring schemes which use systematic sampling protocols are needed to generate increasingly robust data on trends in illegal killing/taking over time and help stakeholders prioritise conservation actions to address this international conservation problem. Large numbers of birds are also hunted legally in the region, but specific totals are generally unavailable. Such data, in combination with improved estimates for illegal killing/taking, are needed for robustly assessing the sustainability of exploitation of birds.

Kim, S.-H., M.-Y. Park, H.-J. Kim, J.-Y. Shin, K.-Y. Ko, D.-G. Kim, M.-K. Kim, H.-G. Kang, B.-J. So, and S.-W. Park. 2016. Analysis of Insecticides in Dead Wild Birds in Korea from 2010 to 2013. *Bulletin of Environmental Contamination and Toxicology* **96**:25–30.

(Abstract)

Wild birds are exposed to insecticides in a variety of ways, at different dose levels and via multiple routes, including ingestion of contaminated food items, and dermal, inhalation,

preening, and embryonic exposure. Most poisoning by insecticides occurs as a result of misuse or accidental exposure, but intentional killing of unwanted animals also occurs. In this study, we investigated insecticides in the gastric contents of dead wild birds that were suspected to have died from insecticide poisoning based on necropsy. The wild birds were found dead in various regions and locations such as in mountains, and agricultural and urban areas. A total of 182 dead wild birds of 27 species were analyzed in this study, and insecticide residue levels were determined in 60.4 % of the total samples analyzed. Monocrotophos and phosphamidon were the most common insecticides identified at rates of 50.0 % and 30.7 % of the insecticide-positive samples, respectively. Other insecticides identified in dead wild birds included organophosphorous, organochlorine and carbamate insecticides. However, there was limited evidence to conclusively establish the cause of death related to insecticides in this study. Nevertheless, considering the level of insecticide exposure, it is speculated that the exposure was mainly a result of accidental or intentional killing, and not from environmental residue.

Fort, J., D. Grémillet, G. Traisnel, F. Amélineau, and P. Bustamante. 2016. Does temporal variation of mercury levels in Arctic seabirds reflect changes in global environmental contamination, or a modification of Arctic marine food web functioning? *Environmental Pollution* **211**:382-388.

(Abstract)

Studying long-term trends of contaminants in Arctic biota is essential to better understand impacts of anthropogenic activities and climate change on the exposure of sensitive species and marine ecosystems. We concurrently measured temporal changes (2006-2014) in mercury (Hg) contamination of little auks (*Alle alle*; the most abundant Arctic seabird) and in their major zooplankton prey species (Calanoid copepods, *Themisto libellula*, *Gammarus*spp.). We found an increasing contamination of the food-chain in East Greenland during summer over the last decade. More specifically, bird contamination (determined by body feather analyses) has increased at a rate of 3.4% per year. Conversely, bird exposure to Hg during winter in the northwest Atlantic (determined by head feather analyses) decreased over the study period (at a rate of 1.5% per year), although winter concentrations remained consistently higher than during summer. By combining mercury levels measured in birds and zooplankton to isotopic analyses, our results demonstrate that inter-annual variations of Hg levels in little auks reflect changes in food-chain contamination, rather than a reorganization of the food web and a modification of seabird trophic ecology. They therefore underline the value of little auks, and Arctic seabirds in general, as bio-indicators of long-term changes in environmental contamination.

Abbasi, N. A., R. N. Malik, A. Frantz, and V. L. Bernard Jaspers. 2016. A review on current knowledge and future prospects of organohalogen contaminants (OHCs) in Asian birds. *Science of the Total Environment* **542**:411–426.

(Abstract)

The release of harmful chemicals in the Asian environment has recently increased dramatically due to rising industrial and agricultural activities. About 60% of the global human population is currently living on the Asian continent and may thus be exposed to a large range of different chemicals. Different classes of organohalogen chemicals have indeed been reported in various environmental compartments from Asia including humans and wildlife, but this issue has received less attention in birds. In this article, we reviewed the available literature on levels of legacy persistent organic pollutants (POPs) and various flame retardants (FRs) in Asian avifauna to analyze the existing pool of knowledge as well as to identify the gaps that should be addressed in future research. Furthermore, we discussed the variation in levels of organohalogens based on differences in regions, trophic level, dietary sources and migratory behaviors of species including distribution patterns in different tissues of birds. Although the mass of published literature is very low and even absent in many important regions of Asia, we deduced from the reported studies that levels of almost all classes of organohalogens (OHCs) including FRs were highest in East Asian countries such as Japan, China and South Korea, except for HCHs that were found at maximum levels in birds of South India. Concentrations (ng/g LW) of different OHCs in Asian birds ranged between bLOD (limit of detection) to 14,000,000 for polychlorinated biphenyls (PCBs), bLOD to 790,000 for dichlorodiphenyltrichloroethane (DDTs), bLOD to 12,000 for hexachlorobenzene (HCB), bLOD to 29,000 for hexachlorocyclohexanes (HCHs), bLOD to 47,000 for chlordanes (CHLs) and bLOD to 4600 for total cyclodienes. Further, ranges (ng/g LW) of 1.1 to 150,000 for Co-PCBs; bLOD to 27 for polychlorinated dibenzo-p-dioxins (PCDDs); bLOD to 45 for polychlorinated dibenzofurans (PCDFs) and 0.02 to 73 for PCDD/DFs have been reported in Asian aves. Among emerging FRs, levels of total polybrominated diphenyl ethers (PBDEs), total dechlorane plus (DPs) [syn and anti DPs] and hexabromocyclododecane (HBCDs) oscillated between bLOD to 134,000, bLOD to 3820 [b0.1–920 and b0.1–2900], and bLOD to 11,800 ng/g LW, respectively. Corresponding ranges of novel brominated flame retardants (nBFRs) such as decabromodiphenyl ethane (DBDPE) and 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE) were bLOD to 820 and bLOD to 89 ng/g LW. Other nBFRs such as tetrabromobisphenol-A (TBBPA) hexabromobenzene (HBB) and pentabromoethylbenzene (PBEB) in Asian avifauna have been reported in very few studies. Dependence of organohalogens on dietary sources and subsequent biomagnification in the food chain has been corroborated through δ15N and δ13C stable isotope proxies. In general, tissues with higher fat content accumulated more organohalogens and vice versa. Aspects such as maternal transfer of OHCs and temporal trends have rarely been discussed in reported literature from Asia. The mobility of birds, vicinity to sources and trans-boundary movement of pollutants were identified as key exposure routes and subsequent OHCs contamination in Asian birds. There is extreme scarcity of literature on organohalogen contamination in birds from Northern, South-eastern and west Asian countries where an industrial boom has been witnessed in the past few decades. Current scenarios suggest that levels of OHCs, particularly the FRs, are rising in birds of Asia and it would be wise to develop baseline information and to regulate the OHCs emission accordingly.

Masden, E. A., and A. S. C. P. Cook. 2016. Avian collision risk models for wind energy impact assessments. *Environmental Impact Assessment Review* **56**:43–49.

(Abstract)

With the increasing global development of wind energy, collision risk models (CRMs) are routinely used to assess the potential impacts of wind turbines on birds. We reviewed and compared the avian collision risk models currently available in the scientific literature, exploring aspects such as the calculation of a collision probability, inclusion of stationary components e.g. the tower, angle of approach and uncertainty. 10 models were cited in the literature and of these, all included a probability of collision of a single bird colliding with a wind turbine during passage through the rotor swept area, and the majority included a measure of the number of birds at risk. 7 out of the 10 models calculated the probability of birds colliding, whilst the remainder used a constant. We identified four approaches to calculate the probability of collision and these were used by others. 6 of the 10 models were deterministic and included the most frequently used models in the UK, with only 4 including variation or uncertainty in some way, the most recent using Bayesian methods. Despite their appeal, CRMs have their limitations and can be 'data hungry' as well as assuming much about bird movement and behaviour. As data become available, these assumptions should be tested to ensure that CRMs are functioning to adequately answer the questions posed by the wind energy sector.

Threats 2015

Sabatier, R., D. Durant, S. Ferchichi, K. Haranne, F. Léger, and M. Tichit. 2015. Effect of cattle trampling on ground nesting birds on pastures: an experiment with artificial nests. *European Journal of Ecology* **1**:5-11.

(Abstract)

1. In semi-natural grasslands, nest trampling by cattle can have a strong effect on hatching success but the relationship linking cattle density, incubation time and nest survival has for now only been hypothesized.

2. Based on an experiment with artificial nests, the objective of this study was to test the theoretical model generally used to estimate nest survival. In spring 2009, we conducted a one-month experiment on permanent grasslands of the French western marshlands grazed at three different stocking rates (1 LU/ha, 2 LU/ha and 4 LU/ha).

3. The results confirmed that trampling depended on stocking rates.

4. Trampling had a major effect on nest survival (32–85% of nests destroyed).

5. The theoretical model classically used by managers and modellers proved to be a good approximation of the dynamics of nest trampling.

6. Synthesis and applications: We conclude that nest trampling has a major impact on nest survival in pastures and that the use of such a model could help managers to define acceptable levels of cattle densities.

Arcilla, N., C.-Y. Choi, K. Ozaki, and C. A. Lepczyk. 2015. Invasive species and Pacific island bird conservation: a selective review of recent research featuring case studies of Swinhoe's storm petrel and the Okinawa and Guam rail. *Journal of Ornithology* **156**:S199–S207.

(Abstract)

Nowhere are the negative impacts of invasive species, such as ecosystem modification, predation, parasitism, and disease, more apparent than in the Pacific islands, where human contact triggered a massive avian extinction event that is still ongoing. Island bird species are inherently vulnerable to extinction due to their small, isolated populations and lack of evolved defenses against many predators. To prevent further extinctions, effective bird conservation strategies must be implemented to mitigate invasive species' impacts, which often interact synergistically and collectively comprise some of the greatest threats to global biodiversity. At the 2014 International Ornithological Congress in Tokyo, Japan, researchers convened a symposium to address research and management of invasive species to benefit Pacific island bird conservation. Speakers presented research and conservation efforts from Japan, Korea, Guam, the Galapagos, and New Zealand, highlighting novel, poorly known threats to birds (e.g., mortality from invasive plant entanglement and invasive nest parasites) and providing updates on ongoing efforts to prevent island endemic species extinctions driven by invasive predators. In this paper we provide new details of research and conservation efforts on Swinhoe's storm petrel (*Oceanodroma monhris*), the Okinawa rail (*Gallirallus okinawae*), and the Guam rail (*G. owstoni*), and put this research in context by briefly reviewing and synthesizing other relevant, recent studies on impacts of invasive species as they affect Pacific island bird conservation. We conclude by highlighting successful management strategies, recommending improvements for ongoing conservation efforts, and suggesting directions for future research.

Uden, D. R., C. R. Allen, A. A. Bishop, R. Grosse, C. F. Jorgensen, T. G. Lagrange, R. G. Stutheit, and M. P. Vrtiska. 2015. Predictions of future ephemeral springtime waterbird stopover habitat availability under global change. *Ecosphere* **6**:Article 215. 211-226.

(Abstract)

In the present period of rapid, worldwide change in climate and land use (i.e., global change), successful biodiversity conservation warrants proactive management responses, especially for long-distance migratory species. However, the development and implementation of management strategies can be impeded by high levels of uncertainty and low levels of control over potentially impactful future events and their effects. Scenario planning and modeling are useful tools for expanding perspectives and informing decisions under these conditions. We coupled scenario planning and statistical modeling to explain and predict playa wetland inundation (i.e., presence/absence of water) and ponded area (i.e., extent of water) in the Rainwater Basin, an anthropogenically altered landscape that provides critical stopover habitat for migratory waterbirds. Inundation and ponded area models for total wetlands, those embedded in row crop fields, and those not embedded in row crop fields were trained and tested with wetland ponding data from 2004 and 2006–2009, and then used to make additional predictions under two alternative climate change scenarios for the year 2050, yielding a total of six predictive models and 18 prediction sets. Model performance ranged from moderate to good, with inundation models outperforming ponded area models, and models for non-row crop-embedded wetlands outperforming models for total wetlands and row crop-embedded wetlands. Model predictions indicate that if the temperature and precipitation changes assumed under our climate change scenarios occur, wetland stopover habitat availability in the Rainwater Basin could decrease in the future. The results of this and similar studies could be aggregated to increase knowledge about the potential spatial and temporal distributions of future stopover habitat along migration corridors, and to develop and prioritize multi-scale management actions aimed at mitigating the detrimental effects of global change on migratory waterbird populations.

Prop, J., J. Aars, B.-J. Bårdsen, S. A. Hanssen, C. Bech, S. Bourgeon, J. de Fouw, G. W. Gabrielsen, J. Lang, E. Noreen, T. Oudman, B. Sittler, L. Stempniewicz, I. M. Tombre, E. Wolters, and B. Moe. 2015. Climate change and the increasing impact of polar bears on bird populations. *Frontiers in Ecology and Evolution* **3**:1-12.

(Abstract)

The Arctic is becoming warmer at a high rate, and contractions in the extent of sea ice are currently changing the habitats of marine top-predators dependent on ice. Polar bears (Ursus maritimus) depend on sea ice for hunting seals. For these top-predators, longer ice-free seasons are hypothesized to force the bears to hunt for alternative terrestrial food, such as eggs from colonial breeding birds. We analyzed time-series of polar bear observations at four locations on Spitsbergen (Svalbard) and one in east Greenland. Summer occurrence of polar bears, measured as the probability of encountering bears and the number of days with bear

presence, has increased significantly from the 1970/80s to the present. The shifts in polar bear occurrence coincided with trends for shorter sea ice seasons and less sea ice during the spring in the study area. This resulted in a strong inverse relationship between the probability of bear encounters on land and the length of the sea ice season. Within ten years after their first appearance on land, polar bears had advanced their arrival dates by almost 30 days. Direct observations of nest predation showed that polar bears may severely affect reproductive success of the barnacle goose (*Branta leucopsis*), common eider (*Somateria mollissima*) and glaucous gull (*Larus hyperboreus*). Nest predation was strongest in years when the polar bears arrived well before hatch, with more than 90% of all nests being predated. The results are similar to findings from Canada, and large-scale processes, such as climate and subsequent habitat changes, are pinpointed as the most likely drivers in various parts of the Arctic. We suggest that the increasing, earlier appearance of bears on land in summer reflects behavioral adaptations by a small segment of the population to cope with a reduced hunting range on sea ice. This exemplifies how behavioral adaptations may contribute to the cascading effects of climate change.

Mondain-Monval, J.-Y., P. Defos du Rau, M. Guillemain, and A. Olivier. 2015. Switch to non-toxic shot in the Camargue, France: effect on waterbird contamination and hunter effectiveness. *European Journal of Wildlife Research* **61**:271–283.

(Abstract)

The use of lead shot for wildfowling is a severe threat to waterbirds through ingestion of toxic lead pellets. Consequently, lead shot has been banned in many countries since the late 1990s and on Tour du Valat estate since 1994 (Camargue, France). An experimental study was undertaken to check if hunters would habituate to this new type of cartridge and consequently improve their effectiveness (average number of shots per bagged animal), assess the factors influencing effectiveness, and assess the trend of contamination in shot waterbirds and the estate sediment. From 1995 to 2005, we monitored hunting bags, spent cartridges, and the gizzards of shot ducks. Using generalized mixed effect models, we assessed the factors influencing hunter effectiveness. Instances of non-toxic pellets in duck gizzards increased, probably as a result of rapid accumulation in the sediments. We estimated that between 1995 and 2005, the lead shot ban spared 456 kg of lead from entering 403 ha of temporary marshes and avoided the contamination of 8 % of the ducks foraging on Tour du Valat. After 11 years of hunting with nontoxic shot, there was unexpectedly no clear pattern in trends of individual effectiveness among hunters. Hunter effectiveness was instead positively influenced by game abundance and hunter assiduity and negatively influenced by wind and number of shots, suggesting a lassitude effect. Our results suggest crippling loss can be reduced through regular practice, self-limitation of shooting intensity to below 20 shots to avoid lassitude effects, and self-limitation of shooting distance under strong wind conditions.

Wilcox, C., E. Van Sebille, and B. D. Hardesty. 2015. Threat of plastic pollution to seabirds is global, pervasive, and increasing. *PNAS* **112**:11899–11904.

(Abstract)

Plastic pollution in the ocean is a global concern; concentrations reach 580,000 pieces per km2 and production is increasing exponentially. Although a large number of empirical studies provide emerging evidence of impacts to wildlife, there has been little systematic assessment of risk. We performed a spatial risk analysis using predicted debris distributions and ranges for 186 seabird species to model debris exposure. We adjusted the model using published data on plastic ingestion by seabirds. Eighty of 135 (59%) species with studies reported in the literature between 1962 and 2012 had ingested plastic, and, within those studies, on average 29% of individuals had plastic in their gut. Standardizing the data for time and species, we estimate the ingestion rate would reach 90% of individuals if these studies were conducted today. Using these results from the literature, we tuned our risk model and were able to capture 71% of the variation in plastic ingestion based on a model including exposure, time, study method, and body size. We used this tuned model to predict risk across seabird species at the global scale. The highest area of expected impact occurs at the Southern Ocean boundary in the Tasman Sea between Australia and New Zealand, which contrasts with previous work identifying this area as having low anthropogenic pressures and concentrations of marine debris. We predict that plastics ingestion is increasing in seabirds, that it will reach 99% of all species by 2050, and that effective waste management can reduce this threat.

Mallory, M. L., B. M. Braune, J. F. Provencher, D. B. Callaghan, H. G. Gilchrist, S. T. Edmonds, K. A. Allard, and N. J. O'Driscoll. 2015. Mercury concentrations in feathers of marine birds in Arctic Canada. *Marine Pollution Bulletin* **98**:308–313.

(Abstract)

Mercury (Hg) concentrations are a concern in the Canadian Arctic, because they are relatively high compared to background levels and to similar species farther south, and are increasing in many wildlife species. Among marine birds breeding in the Canadian Arctic, Hg concentrations have been monitored regularly in eggs and intermittently in livers, but feathers have generally not been used as an indicator of Hg exposure or burden. We examined Hg concentrations in six marine bird species in the Canadian Arctic. Ivory gull *Pagophila eburnea*, feather Hg was exceptionally high, while glaucous gull *Larus hyperboreus* feather Hg was unexpectedly low, and ratios of feather THg to egg THg varied across species. The proportion of total Hg that was comprised of methyl Hg in ivory gull feathers was lower than in other species, and may be related to photo-demethylation or keratin breakdown in semi-opaque feather tissue.

English, M. D., G. J. Robertson, S. Avery-Gomm, D. Pirie-Hay, S. Roul, P. C. Ryan, S. I. Wilhelm, and M. L. Mallory. 2015. Plastic and metal ingestion in three species of coastal waterfowl wintering in Atlantic Canada. *Marine Pollution Bulletin* **98**:349–353.

(Abstract)

Relatively little attention has been paid to the occurrence of anthropogenic debris found in coastal species, especially waterfowl. We examined the incidence of ingested plastic and metal in three waterfowl species wintering in Atlantic Canada: American black ducks (*Anas rubripes*) and mallards (*A. platyrhynchos*), two species that use marine and freshwater coastal habitats for foraging in the winter, and common eider (*Somateria mollissima*), a coastal marine species that feeds on intertidal and subtidal benthic organisms. Plastic was found in the stomachs of 46.1% (6/13) of mallards and 6.9% (6/87) of black ducks, the first report of ingested anthropogenic debris in these species, while 2.1% (1/48) of eider stomachs contained plastic. Metal was found in the stomachs of 30.8% (4/13) of mallards, 2.3% (2/87) of black ducks, and in 2.1% (1/48) of eiders. Our results indicate that species using coastal marine and freshwater environments are exposed to and ingest anthropogenic debris.

Sinka-Karimi, M. H., A. R. Pourkhabbaz, M. Hassanpour, and J. M. Levengood. 2015. Study on Metal Concentrations in Tissues of Mallard and Pochard from Two Major Wintering Sites in Southeastern Caspian Sea, Iran. *Bulletin of Environmental Contamination and Toxicology* **95**:292–297.

(Abstract)

We examined concentrations of cadmium, chromium, iron, lead and zinc in the kidney, liver, and pectoral muscle of Mallards (*Anas platyrhynchos*; n = 30) and Pochards (*Aythya ferina*; n = 30) from two important wintering sites in the southeastern Caspian Sea in the winter of 2012. Mean lead concentrations (ug/g ww) in livers (2.36 ± 1.00) of Pochard and in kidneys (3.43 ± 0.91) of Mallard exceeded the exposure threshold levels in liver (1.5 ug/g ww) and kidney (3 ug/g ww) of waterfowl. Mean cadmium concentrations in livers (1.63 ± 0.66) of Pochards exceeded the background level of this metal in liver (1 ug/g ww) of waterfowl. Chromium, iron and zinc concentrations were within the normal range as reported in other duck studies. Gender-related and inter-specific variation of metal concentrations in analyzed tissues were observed (t test, $p<0.05$). Our results indicated that waterfowl using the Miankalah and Gomishan International Wetlands are being exposed to elevated concentrations of cadmium and lead.

Tobolka, M., K. M. Zolnierowicz, and N. F. Reeve. 2015. The effect of extreme weather events on breeding parameters of the White Stork *Ciconia ciconia*. *Bird Study* **62**:377–385.

(Abstract)

Capsule: Although the White Stork avoids adverse weather conditions by modifying its arrival and breeding, it cannot avoid extreme weather events during the breeding season.

Aims: To show how extreme weather conditions can influence breeding attempts of a large, long-lived species, the White Stork.

Methods: We analysed data on arrivals of White Storks in Western Poland from 2005 to 2013 and detailed breeding biology parameters from 2009 to 2013 in relation to weather conditions. We analysed breeding success and breeding failure rate from 1974 to 2013.

Results: In years with a cold March White Storks arrived later than when March was warmer. Frost during incubation negatively influenced the hatching success. Extreme weather events caused high late mortality even for nestlings older than 30 days. Data from 27 breeding seasons showed a significant increase in mean breeding success but also a significant increase in the proportion of pairs which lost broods in the nestling stage.

Conclusion: The White Stork can modify its arrival in response to current weather conditions on the breeding grounds but it cannot respond to extreme weather events. Due to increasing frequency of extreme weather events caused by climate change, White Stork breeding success may decrease in the future.

Provencher, J. F., A. Bond, and M. Mallory. 2015. Marine birds and plastic debris in Canada: a national synthesis, and a way forward. *Environmental Reviews* **23(1)**: 1-13.

(Abstract)

Marine plastic ingestion by seabirds was first documented in the 1960s, but over 50 years later our understanding about the prevalence, intensity and subsequent effect of plastic pollution in the oceans is still developing. In Canada, systematic assessments using recognized standard protocols began only in the mid-2000s. With marine plastic pollution identified by the United Nations Environmental Program (UNEP) as one of the most critical challenges for the environment, a greater understanding of how plastics affect marine birds in Canada, along with a national strategy is timely and necessary. In order to better understand which and how many marine birds are affected by marine debris we reviewed reports of plastic ingestion and nest incorporation in Canada. Of the 91 marine bird species found in Canadian waters, detailed plastic ingestion data from multiple years and locations are available for only six species. Another 33 species have incidental reports, and we lack any data on dozens more. Future monitoring efforts should focus on characterizing the risk of plastic ingestion among understudied species, and on continued monitoring of species that are known indicators of

plastic pollution internationally and found in multiple regions of Canada to facilitate comparisons at the national and international levels.

Martín, B., S. Delgado, A. de la Cruz, S. Tirado, and M. Ferrer. 2015. Effects of human presence on the long-term trends of migrant and resident shorebirds: evidence of local population declines. *Animal Conservation* **18**:73–81.

(Abstract)

This study examines the responses to human presence of the most abundant shorebird species in an important coastal migration staging area (Los Lances Beach, southern Spain). Long-term census data were used to assess the relationship between bird abundances and human densities and to determine population trends. In addition, changes in individual bird behaviour in relation to human presence were evaluated by direct observation of a shorebird resident species. Our results show that a rapid increase in the recreational use of the study area in summer has dramatically reduced the number of shorebirds and gulls which occur, limiting the capacity of the site as a post-breeding stop-over area. In addition, the presence of people at the beach significantly reduced the time that resident species spent consuming prey. Negative effects of human presence on bird abundance remain constant over the study period, showing no habituation to human disturbance in any of the studied species. Moreover, although intense human disturbance at Los Lances Beach occurs mainly in summer, the human presence observed is sufficient to have a negative impact on the long-term trends of a resident shorebird species. The impacts of disturbance detected on shorebirds and gulls may be reversible through management actions that decrease human presence. We suggest a minimum distance of 80 m for any track or walkway from those areas where shorebirds are usually present, particularly during spring and summer, as well as an appropriate fencing in the most sensitive area.

Falkowska, L., and A. R. Reindl. 2015. Dietary exposure to, and internal organ transfer of, selected halogenated organic compounds in birds eating fish from the Southern Baltic. *Journal of Environmental Science and Health*, Part A: Toxic/Hazardous Substances and Environmental Engineering **50**:1029-1039.

(Abstract)

The aim of this study was to assess the effect of a marine diet on the accumulation, magnification, maternal transfer and detoxification of chlorinated organic pollutants on the highest trophic level in the Baltic Sea. Results showed that birds eating whole herring received the highest doses of herbicides > pesticides > fungicides > polychlorinated dibenzofurans (PCDFs) > polychlorinated dibenzo-para-dioxins (PCDDs). The toxicity of PCDD/Fs in a

penguin's 24-h alimentary exposure was estimated at 7.77 ng TEQ-WHO2005. Among pesticides, the highest concentrations—both in fish and penguin tissue—were those of the pp-DDE isomer. In terms of herbicides, simazine and terbutrine were predominant. The majority of Persistent Organic Pollutants (POPs) underwent accumulation and magnification, and these factors were observed to increase with the birds' age. Guano was found to be an effective means of elimination for all of the studied xenobiotics. Maternal transfer of PCDD/Fs into eggs from internal tissues was most prominent for highly chlorinated dioxins and low chlorinated furans.

Kenow, K. P., M. W. Meyer, R. Rossmann, B. R. Gray, and M. T. Arts. 2015. Influence of in ovo mercury exposure, lake acidity, and other factors on Common Loon egg and chick quality in Wisconsin. *Environmental Toxicology and Chemistry* **34**:1870–1880.

(Abstract)

A field study was conducted in Wisconsin (USA) to characterize in ovo mercury (Hg) exposure in common loons (*Gavia immer*). Total Hg mass fractions ranged from 0.17 mg/g to 1.23mg/g wet weight in eggs collected from nests on lakes representing a wide range of pH (5.0–8.1) and were modeled as a function of maternal loon Hg exposure and egg laying order. Blood total Hg mass fractions in a sample of loon chicks ranged from 0.84 mg/g to 3.86 mg/g wet weight at hatch. Factors other than mercury exposure that may have persistent consequences on development of chicks from eggs collected on low-pH lakes (i.e., egg selenium, calcium, and fatty acid mass fractions) do not seem to be contributing to reported differences in loon chick quality as a function of lake pH. However, it was observed that adult male loons holding territories on neutral-pH lakes were larger on average than those occupying territories on low-pH lakes. Differences in adult body size of common loons holding territories on neutral-versus low-pH lakes may have genetic implications for differences in lake-source-related quality (i.e., size) in chicks. The tendency for high in ovo Hg exposure and smaller adult male size to co-occur in low-pH lakes complicates the interpretation of the relative contributions of each to resulting chick quality.

Vidal, M., and J. Domínguez. 2015. Did the Prestige oil spill compromise bird reproductive performance? Evidences from long-term data on the Kentish Plover (*Charadrius alexandrinus*) in NW Iberian Peninsula. *Biological Conservation* **191**:178–184.

(Abstract)

The NW Iberian Kentish Plover population inhabits sparsely vegetated beaches for foraging, roosting, nesting and rearing young. The lifestyle of this population makes them particularly vulnerable to oil spill pollution. We analyzed long-term data on breeding success, egg structure,

female condition and breeding effort to ascertain the effects of Prestige oil on reproductive performance and length of time of reproductive disruption. The results showed temporal variation to A-egg volume and a change in the pattern of intraclutch egg-size. Eggshell thickness declined in the years following the oil spill and slightly recovered eight years later. A similar decline was observed in female mass and condition. Egg fertility was significantly different before and after the Prestige oil spill, although the low hatching success could have caused this parameter to be underestimated. Nest desertion, which is rare in this population, occurred only in the post-Prestige period. Our study revealed that exposure of the Kentish Plover to the Prestige oil spill adversely affected their reproductive performance by altering the condition of individual members of the population and by changing egg quality for more than just the immediate years after the spill event. The extent of the effects of the spill event on population dynamics could be underestimated due to low hatching and fledging success.

Choi, C.-Y., C.-W. Kang, E.-M. Kim, S. Lee, K.-H. Moon, M.-R. Oh, T. Yamauchi, and Y.-M. Yun. 2014. Ticks collected from migratory birds, including a new record of *Haemaphysalis formosensis*, on Jeju Island, Korea. *Exp Appl Acarol* **62**:557–566.

(Abstract)

Migratory birds may disperse parasites across ecological barriers, and recent climate change may alter the pattern of ectoparasite dispersal via changed patterns of bird migration. In order to document the parasitization of migratory birds by Ixodidae ticks on Jeju Island in Korea, we examined 934 migratory birds comprising 75 species for ticks from 2010 to 2012. In total, 313 ticks were collected from 74 migratory birds across 17 avian species and identified based on morphological keys. These ticks represented six species: *Haemaphysalis flava*, *H. formosensis*, *H. longicornis*, *H. concinna*, *Ixodes turdus* and *I. nipponensis*. Of particular note was the presence of *H. formosensis*, a species not previously reported to have been found in Korea, and *H. concinna*, which had not been previously reported on Jeju Island. The dominant tick species found were *H. flava* (226 ticks, 72.2 %) and *I. turdus* (54 ticks, 17.3 %), and ground-dwelling thrushes such as Pale thrushes (*Turdus pallidus*; 39 birds, 52.7 %) were the most important hosts. Although *H. longicornis* is the most abundant and prevalent terrestrial tick on Jeju Island, the species accounted for only 3.8 % of the total ticks collected in this study, suggesting that ticks on migratory birds may differ from the local tick fauna and that exotic ticks may be introduced via migratory birds. Therefore, long-term programs for tick and tick-borne disease surveillance are recommended to understand the role of migratory animals in the introduction of exotic species and associated pathogens and in life cycles of ticks at different stages in this region.

Huber, S., N. A. Warner, T. Nygård, M. Remberger, M. Harju, H. T. Uggerud, L. Kaj, and L. Hanssen. 2015. A broad cocktail of environmental pollutants found in eggs of three seabird species from remote colonies in Norway. *Environmental Toxicology and Chemistry* **34**:1296–1308.

(Abstract)

Eggs of 3 seabird species, common eider (*Somateria mollisima*), European shag (*Phalacrocorax aristotelis aristotelis*), and European herring gull (*Larus argentatus*), were surveyed for a broad range of legacy and emerging pollutants to assess chemical mixture exposure profiles of seabirds from the Norwegian marine environment. In total, 201 chemical substances were targeted for analysis ranging from metals, organotin compounds, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and associated metabolites, chlorinated paraffins, chlorinated and nonchlorinated organic pesticides, per- and polyfluoroalkyl substances (PFAS), dechlorane plus, octachlorostyrene, brominated flame retardants (BFRs), organophosphorous compounds, brominated and alkyl phenols, cyclic siloxanes, and phthalates. Of the chemicals targeted, 149 substances were found above the detection limits, with metals dominating the contaminant profile and comprising 60% of the total contaminant load. Polychlorinated biphenyls, pesticides, organophosphorous compounds, and PFAS were the dominant contaminant classes of organic pollutants found within the seabird species, with the highest loads occurring in herring gulls, followed by shag, and common eider. New generation pollutants (e.g., PFAS, organophosphorous compounds, and alkylphenols) were detected at similar or higher concentrations than the legacy persistent organic pollutants (POPs). Time trends of reported concentrations of legacy POPs appear to have decreased in recent decades from the Norwegian coastal environment. Concentrations of detected pollutants do not appear to have a negative effect on seabird population development within the sampling area. Additional stress caused by pollutants, however, may affect seabird health more at the individual level.

Dowding, J. E., T. G. Lovegrove, J. Ritchie, S. N. Kast, and M. Puckett. 2006. Mortality of northern New Zealand dotterels (*Charadrius obscurus aquilonius*) following an aerial poisoning operation. *Notornis* **53**:235-239.

(Abstract)

The anticoagulant brodifacoum is widely used for the control and eradication of vertebrate pests in New Zealand. During poisoning operations with this toxin, some native birds eat baits and die. Because brodifacoum persists in the environment, other birds may suffer secondary poisoning from eating animals that have ingested the poison baits. We describe here high mortality of New Zealand dotterels (*Charadrius obscurus*) following an aerial brodifacoum operation at Tawharanui Regional Park, North Auckland, in 2004. At least 50% of the dotterels in the area at the time of the operation disappeared or were found dead; one bird found freshly dead had a high level of brodifacoum residue. Sandhoppers (*Talorchestia* spp.) are a common food item of New Zealand dotterels. Sandhoppers at Tawharanui ate baits and accumulated

brodifacoum and provided a potential route for transmission of the toxin to dotterels. Three pied stilts (*Himantopus himantopus*) and one spur-winged plover (*Vanellus miles novaehollandiae*) were also found dead. These records appear to be the first to document probable secondary poisoning of shorebirds in New Zealand. There was no apparent mortality of variable oystercatchers (*Haematopus unicolor*). Measures are suggested to reduce shorebird mortality in future operations of this type. Monitoring of New Zealand dotterels and other shorebirds during other types of poisoning operations in coastal areas is also recommended.

Murray, N. J., Z. Ma, and R. A. Fuller. 2015. Tidal flats of the Yellow Sea: A review of ecosystem status and anthropogenic threats. *Austral Ecology* **40**:472–481.

(Abstract)

Tidal flats provide ecosystem services to billions of people worldwide, yet their changing status is largely unknown. In the Yellow Sea region of East Asia, tidal flats are the principal coastal ecosystem fringing more than 4000 km of the coastlines of China, North Korea and South Korea. However, widespread loss of areal extent, increasing frequency of algal blooms, hypoxic dead zones and jellyfish blooms, and declines of commercial fisheries and migratory bird populations suggest that this ecosystem is degraded and declining. Here, we apply the International Union for Conservation of Nature Red List of Ecosystems criteria to the Yellow Sea tidal flat ecosystem and determine that its status is endangered. Comparison of standardized remotely sensed habitat data and historic topographic map data indicated that in the last 50 years, a decline of more than 50% but less than 80% of tidal flat extent has occurred (criterion A1). Although restricted to a narrow band along the coastline, Yellow Sea tidal flats are sufficiently broadly distributed to be classified as least concern under criterion B. However, widespread pollution, algal blooms and declines of invertebrate and vertebrate fauna across the region result in a classification of endangered (C1, D1). Owing to the lack of long-term monitoring data and the unknown impacts of severe biotic and abiotic change, the ecosystem was scored as data deficient for Criterion E and several subcriteria. Our assessment demonstrates an urgent need to arrest the decline of the Yellow Sea tidal flat ecosystem, which could be achieved by (i) improved coastal planning and management at regional and national levels, (ii) expansion of the coastal protected area network, and (iii) improved managed of existing protected areas to reduce illegal land reclamation and coastal exploitation.

Brabant, R., N. Vanermen, E. W. M. Stienen, and S. Degraer. 2015. Towards a cumulative collision risk assessment of local and migrating birds in North Sea offshore wind farms. *Hydrobiologia* **756**:63–74.

(Abstract)

Bird collision assessments are generally made at the scale of a single wind farm. While especially in offshore situations such assessments already hold several assumptions, even bigger challenges exist on estimating the cumulative impact of multiple wind farms and the impacts at population level. In this paper, the number of collision victims at Belgian offshore wind farms was estimated with a (theoretical) collision risk model based on technical turbine specifications, bird-related parameters and bird density data of both local seabirds and passerine migrants. Bird density data were gathered by visual censuses and radar registrations. The outcome of the model was extrapolated to future development scenarios in the Belgian part of the North Sea and in the entire North Sea, and then further used for a preliminary assessment of the impact at population level for the species at risk. The results indicate that the cumulative impact of a realistic scenario of 10,000 turbines in the North Sea might have a significant negative effect at population level for lesser and great black-backed gull. We further show that during a single night of intense songbird migration, the number of collision victims among passerine migrants might be in the order of magnitude of several thousands in the entire North Sea. We argue that it is of great importance to further develop methods to quantify the uncertainties and to minimise the assumptions, in order to assure more reliable cumulative impact assessments.

Fijn, R. C., K. L. Krijgsveld, M. J. M. Poot, and S. Dirksen. 2015. Bird movements at rotor heights measured continuously with vertical radar at a Dutch offshore wind farm. *Ibis* **157**:558–566.

(Abstract)

Assessing the impacts of avian collisions with wind turbines requires reliable estimates of avian flight intensities and altitudes, to enable accurate estimation of collision rates, avoidance rates and related effects on populations. At sea, obtaining such estimates visually is limited not only by weather conditions but, more importantly, because a high proportion of birds fly at night and at heights above the range of visual observation. We used vertical radar with automated bird-tracking software to overcome these limitations and obtain data on the magnitude, timing and altitude of local bird movements and seasonal migration measured continuously at a Dutch offshore wind farm. An estimated 1.6 million radar echoes representing individual birds or flocks were recorded crossing the wind farm annually at altitudes between 25 and 115 m (the rotor-swept zone). The majority of these fluxes consisted of gull species during the day and migrating passerines at night. We demonstrate daily, monthly and seasonal patterns in fluxes at rotor heights and the influence of wind direction on flight intensity. These data are among the first to show the magnitude and variation of low-altitude flight activity across the North Sea, and are valuable for assessing the consequences of developments such as offshore wind farms for birds.

Conkling, T. J., J. A. Martin, J. L. Belant, and T. L. DeVault. 2015. Spatiotemporal Dynamics in Identification of Aircraft–Bird Strikes, *Transportation Research Board of the National Academies, Washington, D.C*.

(Abstract)

A primary concern for human–wildlife interactions is the potential impacts resulting from wildlife (primarily birds) collisions with aircraft. The identification of species responsible for collisions with aircraft is necessary so that airport management can develop effective strategies to reduce strikes with those species. Of particular importance in developing such strategies is the identification of regional, seasonal, and temporal patterns in collisions with unidentified bird species that may limit the effectiveness of regional habitat management to reduce bird strikes. The authors analyzed 105,529 U.S. civil aviation strike records from 1990 to 2012 in the FAA's National Wildlife Strike Database to examine patterns of collisions involving unidentified birds. Factors that affected identification were airport certification class, FAA region, mass of struck species, state species richness (if damage was reported), and interactive effects between the last four factors. Identification varied by region and declined with increasing species richness; this identification was greater for general aviation (GA) airports and the mass of struck species, especially when damage was reported. Species identification might be improved by increasing reporting efforts relative to species richness, especially by GA airport managers and operations staff, who may have a higher propensity of reporting bird strikes, and by collecting more field-based data on avian populations. The results can provide guidance for the development of airport management and personnel training.

McConnell, H. M., B. D. Gartrell, B. L. Chilvers, S. T. Finlayson, P. C. E. Bridgen, and K. J. Morgan. 2015. Baseline hydrocarbon levels in New Zealand coastal and marine avifauna. *Marine Pollution Bulletin* **94**:290–298.

(Abstract)

The external effects of oil on wildlife can be obvious and acute. Internal effects are more difficult to detect and can occur without any external signs. To quantify internal effects from oil ingestion by wildlife during an oil spill, baseline levels of ubiquitous hydrocarbon fractions, like polycyclic aromatic hydrocarbons (PAHs), need to be established. With these baseline values the extent of impact from exposure during a spill can be determined. This research represents the first investigation of baseline levels for 22 PAHs in New Zealand coastal and marine avian wildlife. Eighty-five liver samples were tested from 18 species. PAHs were identified in 98% of livers sampled with concentrations ranging from 0 to 1341.6 ng/g lipid wt or on wet wt basis, 0 to 29.5 ng/g. Overall, concentrations were low relative to other globally reported avian values. PAH concentration variability was linked with species foraging habitat and migratory patterns.

Cha, S.-Y., H.-S. Seo, B. Wei, M. Kang, J.-H. Roh, R.-H. Yoon, J.-H. Kim, and H.-K. Jang. 2015. Surveillance and characterization of *Riemerella anatipestifer* from wild birds in South Korea. *Journal of Wildlife Diseases* **51**:341–347.

(Abstract)

We conducted surveillance for *Riemerella anatipestifer* (RA) in wild birds along the East Asian-Australasian flyway in South Korea. Detected RA were characterized by serotype, antibiotic susceptibility, and sequence analysis of the 16S rRNA gene. We collected 944 wild birds of 34 species from 19 of South Korea's major migratory wild bird habitats between 2011 and 2012. We identified RA by PCR and rRNA gene sequence in 71/102 (69.6%) pharyngeal swabs and 19/944 (2.0%) cloacal swabs of wild birds. Most RA positives (71/75 [95%] pharyngeal and 19/704 [(2.6%] cloacal) were from three duck species (family Anatidae): Mallard Duck (*Anas platyrhynchos*), Northern Pintail (*Anas acuta*), and Spot-billed Duck (*Anas poecilorhyncha*). Thirty-three RA isolates obtained and examined were highly resistant to aminoglycosides: kanamycin (100%), gentamicin (94%), amikacin (91%), neomycin (88%), and streptomycin (82%). Six isolates were identified as serotype 4 by agar gel precipitation. Serotypes 1 and 7, which are known virulent serotypes, were also identified in three isolates from wild duck species.

England, K. J. H., C. Jackson, and P. A. R. Hockey. 2015. A novel methodology for the rapid assessment of waterbird vulnerability to disturbance. *Ostrich* **86**:75–85.

(Abstract)

A methodology for rapidly assessing the vulnerability of waterbirds to disturbance was tested at Sabaki estuary, Kenya. Three variables were employed to measure the responses of 15 species: (1) bird density, (2) minimum distance of birds from a stationary disturbance and (3) recovery times following a moving disturbance. Spatial response metrics (1) and (2) were regressed against expected species densities (in the absence of disturbance). Normalised mean residuals then described species-specific deviations from the average spatial response to disturbance. A hypothetical model was constructed, whereby species were placed on a spatial response gradient and overlaid by the recovery metric (3). Greater Flamingo *Phoenicopterus roseus*, Lesser Flamingo *Phoeniconaias minor*, African Spoonbill *Platalea alba* and Terek Sandpiper *Xenus cinereus* exhibited the strongest avoidance responses. The two spatial metrics (1 and 2) achieved concordance for 73% of species, and all three metrics gave similar results for six of seven species at the extremes of the spatial response gradient. Non-concordance between response metrics is likely an effect of life-history traits (e.g. territoriality). Our results support the use of relative spatial response metrics (1 and 2) for robust and rapid identification of waterbird species that are most responsive and, by virtue, vulnerable to the effects of disturbance on tropical estuaries.

Kim, J., and J.-M. Oh. 2015. Trace element contamination in nestling black-tailed gulls (*Larus crassirostris*) in Korea. *Ecotoxicology* **24**:770–778.

(Abstract)

At Hongdo Island, Gyeongsangnam-do, Korea, a breeding site of black-tailed gull (*Larus crassirostris*), we collected nestlings from two locations: a ‘‘reference’’ site (n = 10) with no known source of lead contamination and ‘‘lighthouse’’ site (n = 10) with suspected lead contamination from leaded paint. Iron concentrations in the kidney and bone, manganese in the muscle, copper in the bone, lead in the muscle and bone, and cadmium in the liver, muscle, and bone at the reference site were significantly higher than at the lighthouse. Manganese concentrations in the liver and kidney, and lead in the kidney were significantly greater at the lighthouse than at the reference site. Iron, zinc, manganese, copper, lead and cadmium concentrations had tissue-specific accumulation at both sites. Lead concentrations in 10 % of livers and in 80 % of kidneys at the lighthouse, and in 20 % of livers from the reference were within a range considered toxic ([6.00 lg/g dw in the liver and kidney). Lead concentrations in 50 % of black-tailed gull nestlings at the reference and 80 % nestlings at the lighthouse were greater in livers than in bones, which is suggestive of acute lead exposure. For cadmium, all liver and kidney concentrations from two sites were at a level considered background in birds. Cadmium concentrations of every sample were higher in kidneys than in livers, suggestive of chronic cadmium exposure. Lead concentrations in gull nestlings in the present study were relatively higher than other gull species worldwide, but cadmium concentrations were relatively lower.

Liu, J., J. Liang, X. Yuan, G. Zeng, Y. Yuan, H. Wu, X. Huang, J. Liu, S. Hua, F. Li, and X. Li. 2015. An integrated model for assessing heavy metal exposure risk to migratory birds in wetland ecosystem: A case study in Dongting Lake Wetland, China. *Chemosphere* **135**:14–19.

(Abstract)

Heavy metal contamination is present in wetland ecosystem worldwide, and quantitative risk assessment model is significant. In this study, an exposure model was integrated for assessing heavy metal exposure risk to migratory birds in Dongting Lake Wetland (DTW). The concentrations of Cr, Cu, Pb, Cd, Hg and As in water, plant, soil and fish were investigated from 9 migratory bird habitats. The results showed that exposure doses from drinking water pathways were very low. There was a sensitive area that Cd and As exposure doses exceeded the most conservative tolerable daily intake, which is located at the estuary of Xiang River. In general, Dunlin had a greater risk than Eurasian Spoonbill. Hg, Pb and Cr were likely to have

adverse effect on carnivorous migrants in DTW, while Cu and Cd were considered to be relatively safe. Almost all heavy metals were at no risk for Lesser White-fronted Goose in DTW.

Ferreyra, H., P. M. Beldomenico, K. Marchese, M. Romano, A. Caselli, A. I. Correa, and M. Uhart. 2015. Lead exposure affects health indices in free-ranging ducks in Argentina. *Ecotoxicology* **24**:735–745.

(Abstract)

Numerous experiments under controlled conditions and extensive investigation of waterfowl die-offs have demonstrated that exposure to lead from spent gunshot is highly detrimental to the health of waterfowl. However, few studies have focused on examining the more subtle sub-lethal effects of lead toxicity on ducks in non-experimental settings. In our study, the health of ducks exposed to varying amounts of lead under natural conditions was assessed by correlating individual lead exposure with relevant indices of health. Based on hunter-killed wild ducks in Argentina, we measured spleen mass, body condition, examined bone marrow smears, and determined Ca and P in bone tissue. In free-ranging live-trapped ducks we determined basic hematology and aminolevulinic acid dehydratase activity. Using multivariate analyses, we found that, when controlling for the potential confounding effect of site type, year, duck species, body mass and age, lead levels in the liver were negatively associated with body condition and spleen mass. Spleen mass was also lower in ducks with higher lead levels in their bones. In live ducks, high blood lead levels were associated with low packed cell volume and red cell morphologic abnormalities. These findings suggest that, despite the lack of recorded lead-induced mortality in the region, lead exposure results in less conspicuous but still significant impacts on the health of ducks, which could have serious implications for their conservation. Moreover, this evidence further supports the need for urgently banning lead shot in the region.

Schlacher, T. A., M. A. Weston, D. Lynn, D. S. Schoeman, C. M. Huijbers, A. D. Olds, S. Masters, and R. M. Connolly. 2015. Conservation gone to the dogs: when canids rule the beach in small coastal reserves. *Biodiversity and Conservation* **24**:493–509.

(Abstract)

On most developed coastlines, dunes backing ocean beaches constitute an urbanised landscape mosaic containing remnant pockets of small conservation areas. Urbanised beaches are also prime sites for domestic dogs, known to be environmentally harmful in many other settings. It is unknown, however, whether small, protected parcels of dune are adequate for biological conservation and whether dogs compromise their functional conservation objectives. Here we examine, for two small (2 km ocean boundary) reserves in Eastern

Australia abutting an urban area, whether such small reserves can continue to function as effective conservation instruments on ocean beaches, using scavenger community composition and efficiency to assess ecosystem function. Two nonnative species of canids—domestic dogs (*Canis lupus familiaris*) and red foxes (*Vulpes vulpes*)—were ubiquitous and numerous inside conservation areas, to the point of having become the most abundant vertebrate scavengers at the beach-dune interface, outcompeting native scavengers for wave-cast carrion. Dogs and foxes have effectively supplanted raptors, normally abundant on non-urban beaches in the region, and other avian scavengers, as the principal consumers of animal carcasses both inside the declared reserves and at the urban beach. Whilst the ecological threats posed by foxes are widely and intensively addressed in Australia in the form of fox-control programs, dog controls are less common and stringent. Our data emphasize, however, that managing domestic dogs may be required to the same extent in order to maintain key forms and functions in coastal reserves situated close to urban areas.

Morris, S. R., and B. A. Stumpe. 2015. Limited Impact of a Small Residential Wind Turbine on Birds on an Off-Shore Island in Maine. *Northeastern Naturalist* **22**:95-105.

(Abstract)

We studied the impact of a small, residential wind turbine on birds on Appledore Island, ME, to augment the limited published data on avian fatalities due to residential turbines. We conducted mortality and behavioral surveys of birds flying in the vicinity of the turbine. We did not detect any turbine-related fatalities during twice-daily surveys from fall 2007 to spring 2012, and we have only two anecdotal reports of collision events. Behavioral observations showed that the majority of birds flew below the turbine propeller (95.5%) vertically and near the turbine (53.4%) horizontally. Our behavioral surveys indicated that birds were often seen close to the monopole, but were less likely to be detected near the turbine blades compared to areas more distant from the blades. Furthermore, birds perching on and around the monopole structure provided additional anecdotal evidence of birds not avoiding the vicinity of the wind turbine. Our findings suggest a limited impact of this residential wind turbine on birds. However, we advise carefully choosing the location of a wind turbine so as to minimize potential impacts to avian populations; the turbine on Appledore Island was constructed only after extensive consideration of the possible impacts on birds at this site.

Cestari, C. 2015. Coexistence between Nearctic-Neotropical migratory shorebirds and humans on urban beaches of the Southern Hemisphere: a current conservation challenge in developing countries. *Urban Ecosystems* **18**:285–291.

(Abstract)

The arrival of migratory shorebirds on beaches in urban communities in developing countries is a current challenge for the protection of these migrant birds. Nearctic-Neotropical migrants rely on roosting and feeding sites during their stopover on wintering sites in the Southern Hemisphere to acquire sufficient energy to complete their migratory cycles. On the other hand, cities in the Southern Hemisphere are growing rapidly, which results in increasing competition for space between humans and birds, such as for use in beach habitats. In the present study, I analyze the probability for occurrence for Nearctic-Neotropical migratory birds relative to the number of people in southeastern Brazil, the most populated region of South America. The frequency of occurrence of migrants, their distance of tolerance to people and the number of people were recorded in sample areas (circle plots with 20 m radius) on a 9 km stretch of urban beaches from November to February from 2009 to 2013. The probability of occurrence of Nearctic birds decreased as the number of people increased. When the number of people exceeded 20, the probability of occurrence of birds was almost zero. Furthermore, more than 95% of birds moved off when people were within 16 m of reach. These results are discussed in the context of conservation actions since no management plan has been developed for migrant shorebirds that use urban beaches as stopover or wintering sites in developing countries.

Møller, A. P., and K. Laursen. 2015. Reversible effects of fertilizer use on population trends of waterbirds in Europe. *Biological Conservation* **184**:389–395.

(Abstract)

Nutrients are often limiting primary productivity, and fertilizer use by agriculture increases primary and secondary productivity in marine environments. High levels of eutrophication due to fertilizer use can have negative effects on the distribution and the abundance of many organisms including waterbirds inhabiting freshwater and marine wetlands. Because nutrients, in particular phosphorus, can be stored in sediment, reversal of effects of eutrophication can take considerably longer time than the period during which effects of eutrophication build up. We quantified the effects of fertilizer use on 50 species of freshwater and coastal waterbirds monitored across Europe during 1982–2008 during the increase and the decrease phase of fertilizer use. More species were negatively affected by fertilizer use, and use of marine habitats during winter was the single-most important predictor of negative trends. The relative effect of fertilizer use on abundance of waterbird species was consistent during the increase and the decrease phase of fertilizer use. The effects of fertilizer use were statistically independent of the effects of climate change. Reversal of the effect of fertilizer use on population trends of waterbirds was almost three times as slow as the build-up of effects of nutrients on population size. These findings have management implications for the extent and the duration of fertilizer policies at local, national and international levels since these policies will partly determine the population trends and the population sizes of waterbirds.

Smith, M. M., and A. M. Ramey. 2015. Prevalence and genetic diversity of haematozoa in South American waterfowl and evidence for intercontinental redistribution of parasites by migratory birds. International Journal for Parasitology: *Parasites and Wildlife* **4**:22–28.

(Abstract)

To understand the role of migratory birds in the movement and transmission of haematozoa within and between continental regions, we examined 804 blood samples collected from eleven endemic species of South American waterfowl in Peru and Argentina for infection by *Haemoproteus*, Plasmodium, and/or *Leucocytozoon* blood parasites. Infections were detected in 25 individuals of six species for an overall apparent prevalence rate of 3.1%. Analysis of haematozoa mitochondrial DNA revealed twelve distinct parasite haplotypes infecting South American waterfowl, four of which were identical to lineages previously observed infecting ducks and swans sampled in North America. Analysis of parasite mitochondrial DNA sequences revealed close phylogenetic relationships between lineages originating from waterfowl samples regardless of continental affiliation. In contrast, more distant phylogenetic relationships were observed between parasite lineages from waterfowl and passerines sampled in South America for *Haemoproteus* and *Leucocytozoon*, suggesting some level of host specificity for parasites of these genera. The detection of identical parasite lineages in endemic, South American waterfowl and North American ducks and swans, paired with the close phylogenetic relationships of haematozoa infecting waterfowl on both continents, provides evidence for parasite redistribution between these regions by migratory birds.

Ramey, A. M., J. A. Schmutz, J. A. Reed, G. Fujita, B. D. Scotton, B. Casler, J. P. Fleskes, K. Konishi, K. Uchida, and M. J. Yabsley. 2015. Evidence for intercontinental parasite exchange through molecular detection and characterization of haematozoa in northern pintails (*Anas acuta*) sampled throughout the North Pacific Basin. International Journal for Parasitology: *Parasites and Wildlife* **4**:11–21.

(Abstract)

Empirical evidence supports wild birds as playing a role in the interhemispheric exchange of bacteria and viruses; however, data supporting the redistribution of parasites among continents are limited. In this study, the hypothesis that migratory birds contribute to the redistribution of parasites between continents was tested by sampling northern pintails (*Anas acuta*) at locations throughout the North Pacific Basin in North America and East Asia for haemosporidian infections and assessing the genetic evidence for parasite exchange. Of 878 samples collected from birds in Alaska (USA), California (USA), and Hokkaido (Japan) during August 2011–May 2012 and screened for parasitic infections using molecular techniques, *Leucocytozoon*, *Haemoproteus*, and *Plasmodium* parasites were detected in 555 (63%), 44 (5%), and 52 (6%) samples, respectively. Using an occupancy modeling approach, the probability of detecting parasites via replicate genetic tests was estimated to be high ($\rho > 0.95$). Multi-model inference supported variation of *Leucocytozoon* parasite prevalence by

northern pintail age class and geographic location of sampling in contrast to *Haemoproteus*and Plasmodium parasites for which there was only support for variation in parasite prevalence by sampling location. Thirty-one unique mitochondrial DNA haplotypes were detected among haematozoa infecting northern pintails including seven lineages shared between samples from North America and Japan. The finding of identical parasite haplotypes at widely distributed geographic locations and general lack of genetic structuring by continent in phylogenies for *Leucocytozoon* and Plasmodium provides evidence for intercontinental genetic exchange of haemosporidian parasites. Results suggest that migratory birds, including waterfowl, could therefore facilitate the introduction of avian malaria and other haemosporidia to novel hosts and spatially distant regions.

Burger, J., N. Tsipoura, L. J. Niles, M. Gochfeld, A. Dey, and D. S. Mizrahi. 2015. Mercury, Lead, Cadmium, Arsenic, Chromium and Selenium in Feathers of Shorebirds during Migrating through Delaware Bay, New Jersey: Comparing the 1990s and 2011/2012. *Toxics* **3**:63-74.

(Abstract)

Understanding temporal changes in contaminant levels in coastal environments requires comparing levels of contaminants from the same species from different time periods, particularly if species are declining. Several species of shorebirds migrating through Delaware Bay have declined from the 1980s to the present. To evaluate some contaminants as cause for the declines, we examine levels of mercury, lead, cadmium, arsenic, chromium and selenium in feathers of red knot (*Calidris canutus*, N = 46 individuals), semipalmated sandpiper (*Calidris pusilla*, N = 70) and sanderling (*Calidris alba*, N = 32) migrating through Delaware Bay, New Jersey, USA, from 1991 to 1992 (N = 40), 1995 (N = 28), and 2011–2012 (N = 80) to determine if levels have changed. We found: (1) arsenic, chromium, and lead increased in red knot and decreased in semipalmated sandpiper; (2) cadmium decreased in semipalmated sandpipers; (3) mercury decreased in red knot and sanderlings; (4) selenium decreased in red knot and increased in semipalmated sandpipers. In 2011/2012 there were significant interspecific differences for arsenic, mercury and selenium. Except for selenium, the element levels were well below levels reported for feathers of other species. The levels in feathers in red knots, sanderling, and semipalmated sandpipers from Delaware Bay in 2011/2012 were well below levels in feathers that are associated with effect levels, except for selenium. Selenium levels ranged from 3.0 μg·g−1 dry weight to 5.8 μg·g−1 (semipalmated sandpiper), within the range known to cause adverse effects, suggesting the need for further examination of selenium levels in birds. The levels of all elements were well below those reported for other marine species, except for selenium, which was near levels suggesting possible toxic effects.

Lavoie, R. A., T. K. Kyser, V. L. Friesen, and L. M. Campbell. 2015. Tracking Overwintering Areas of Fish-Eating Birds to Identify Mercury Exposure. *Environmental Science and Technology* **49**:863−872.

(Abstract)

Migration patterns are believed to greatly influence concentrations of contaminants in birds due to accumulation in spatially and temporally distinct ecosystems. Two species of fish-eating birds, the Double-crested Cormorant (*Phalacrocorax auritus*) and the Caspian Tern (*Hydroprogne caspia*) breeding in Lake Ontario were chosen to measure the impact of overwintering location on mercury concentrations ([Hg]). We characterized (1) overwintering areas using stable isotopes of hydrogen (δ^2H) and band recoveries, and (2) overwintering habitats by combining information from stable isotopes of sulfur ($\delta^{34}S$), carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and δ^2H in feathers grown during the winter. Overall, overwintering location had a significant effect on [Hg]. Both species showed high [Hg] in ^{13}C-rich habitats. In situ production of Hg (e.g., through sulfate reducing bacteria in sediments) and allochthonous import could explain high [Hg] in birds visiting ^{13}C-rich habitats. Higher [Hg] were found in birds with high δ2H, suggesting that Hg is more bioavailable in southern overwintering locations. Hotspot maps informed that higher [Hg] in birds were found at the limit of their southeastern overwintering range. Mercury concentrations in winter feathers were positively related to predicted spatial pattern of [Hg] in fish using the National Descriptive Model of Mercury in Fish (NDMMF) based on bird spatial assignment (using δ^2H). This study indicates that the overwintering location greatly influences [Hg].

Liang, J., J. Liu, X. Yuan, G. Zeng, X. Lai, X. Li , H. Wu, Y. Yuan, and F. Li. 2015. Spatial and temporal variation of heavy metal risk and source in sediments of Dongting Lake wetland, midsouth China. *Journal of Environmental Science and Health*, Part A: Toxic/Hazardous Substances and Environmental Engineering **50**:100-108.

(Abstract)

Surface sediments of Dongting Lake wetland were collected from ten sites to investigate variation trend, risk and sources of heavy metal distribution in dry seasons of 2011-2013. The three-year mean concentrations (mg/kg) of Cr, Cu, Pb, Cd, Hg and As were 91.33, 36.27, 54.82, 4.39, 0.19 and 25.67, respectively, which were all higher than the corresponding background values. Sediment quality guidelines (SQGs) and Geo-accumulation index (Igeo) were used for the assessment of pollution level of heavy metals. The pollution risk of Cd, Hg and As were great and that of Cr needed urgent attention because of its obvious increase. Pollution load index (PLI) and geographic information system (GIS) methods were conducted to assess spatial and temporal variation of heavy metal contamination. Results confirmed an increased contamination contribution inflow from Xiang River. Multivariate statistical analyses were applied to identify contribution sources of heavy metal, which showed anthropogenic origin mainly from mining, smelting, chemical industry and agricultural activity.

May, R., O. Reitan, K. Bevanger, S.-H. Lorentsen, and T. Nygård. 2015. Mitigating wind-turbine induced avian mortality: Sensory, aerodynamic and cognitive constraints and options. *Renewable and Sustainable Energy Reviews* **42**:170–181.

(Abstract)

Because of the fast rate of wind-energy development it will become a challenge to verify impacts on birdlife and construe ways to minimise these. Birds colliding with wind turbines are generally perceived as one of the major conflict issues for wind-energy development. Development of effective and practical measures to reduce bird mortality related to offshore and onshore wind energy is therefore paramount to avoid any delay in consenting processes. The expected efficacy of post-construction mitigation measures for wind-turbine induced avian mortality can be expected to be species-specific with regard to audible, optical and biomechanical constraints and options. Species-specific sensory faculties limit the ability to observe a wind turbine in a given circumstance. Their consequent cognitive perception may depend on the possibilities for associating wind turbines with risk, and discriminating these from other sources. Last but not least, perceived risks may only be evaded when their aerodynamic, locomotive physiology enables them to do so in due time. In order to be able to identify and construe functional mitigation measures these aspects need to be taken into account. Measures eliciting a series of intermittent strong stimuli that are variable in frequency may limit habituation effects; these should only be elicited specifically to mitigate imminent collision. Thus measures either adjusting turbine operation or warning/deterring birds approaching turbines are expected to be most functional. Warning signals may either be based on optical or audible stimuli; however, birds' hearing is inferior to humans while their visual acuity and temporal resolution is higher, but with great differences among species. Implementing effective mitigation measures could reduce the general level of conflicts with birdlife and thus enable both the development at new sites, at sites that have been declared having too high conflict levels, and utilise the wind resources better at specific sites without increasing the conflict levels.

Ronconi, R. A., K. A. Allard, and P. D. Taylor. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. *Journal of Environmental Management* **147**:34-45.

(Abstract)

Thousands of oil and gas platforms are currently operating in offshore waters globally, and this industry is expected to expand in coming decades. Although the potential environmental impacts of offshore oil and gas activities are widely recognized, there is limited understanding of their impacts on migratory and resident birds. A literature review identified 24 studies and reports of bird-platform interactions, most being qualitative and half having been peer-

reviewed. The most frequently observed effect, for seabirds and landbirds, is attraction and sometimes collisions associated with lights and flares; episodic events have caused the deaths of hundreds or even thousands of birds. Though typically unpredictable, anecdotally, it is known that poor weather, such as fog, precipitation and low cloud cover, can exacerbate the effect of nocturnal attraction to lights, especially when coincidental with bird migrations. Other effects include provision of foraging and roosting opportunities, increased exposure to oil and hazardous environments, increased exposure to predators, or repulsion from feeding sites. Current approaches to monitoring birds at offshore platforms have focused on observer-based methods which can offer species-level bird identification, quantify seasonal patterns of relative abundance and distribution, and document avian mortality events and underlying factors. Observer-based monitoring is time-intensive, limited in spatial and temporal coverage, and suffers without clear protocols and when not conducted by trained, independent observers. These difficulties are exacerbated because deleterious bird-platform interaction is episodic and likely requires the coincidence of multiple factors (e.g., darkness, cloud, fog, rain conditions, occurrence of birds in vicinity). Collectively, these considerations suggest a need to implement supplemental systems for monitoring bird activities around offshore platforms. Instrument-based approaches, such as radar, cameras, acoustic recordings, and telemetry, hold promise for continuous monitoring. Recommendations are provided for a rigorous and comprehensive monitoring approach within an adaptive management framework.

Øverjordet, I. B., M. B. Kongsrud, G. W. Gabrielsen, T. Berg, A. Ruus, A. Evenset, K. Borgå, G. Christensen, and B. M. Jenssen. 2015. Toxic and essential elements changed in black-legged kittiwakes (Rissa tridactyla) during their stay in an Arctic breeding area. *Science of the Total Environment* **502**:548–556.

(Abstract)

Seasonal fluctuations in mercury (Hg), cadmium (Cd), zinc (Zn), copper (Cu) and selenium (Se) concentrations were studied in black-legged kittiwakes (Rissa tridactyla) from Kongsfjorden, Svalbard (79°57′N, 12°12′E). Element concentrations were determined in muscle and liver tissue in kittiwakes collected in May, July and October 2007. Stable isotopes of carbon (δ13C) and nitrogen (δ15N) were analysed in muscle tissue to calculate trophic position (TP) and examine the possible influence of carbon source on element accumulation. Metallothionein (MT) concentrations in liver, as well as Hg and Cd concentration in size-fractionated liver supernatant were determined to evaluate the association between elements and MT. Mercury concentrations declined from May through July to October in both tissues, while concentrations of Cd were similar in May and July and lower in October. A decline in TP between May an July, indicating a shift from fish-based diet towards an invertebrate-based diet explains the declining Hg concentration. The low Hg and Cd concentrations in October may be a result of an increased elimination, probably related to moulting. Selenium decreased in the same manner as Hg in liver and muscle, possibly related to the formation of Se–Hg complexes. Zinc and Cu did not fluctuate in muscle tissue, whereas hepatic Zn concentrations where highest in May. Hepatic Zn concentrations were higher in females compared to males

in May, possibly related to egg production. Hepatic MT concentrations were lower in October compared to July, following the same trend as Hg and Cd. Cadmium was predominantly bound to the MT fraction of proteins in liver tissue, whereas Hg was associated with the larger proteins, indicating that MT was not sequestering Hg in the kittiwakes.

Abbasi, N. A., V. L. Bernard Jaspers, M. J. I. Chaudhry, S. Ali, and R. N. Malik. 2015. Influence of taxa, trophic level, and location on bioaccumulation of toxic metals in bird's feathers: A preliminary biomonitoring study using multiple bird species from Pakistan. *Chemosphere***120**:527–537.

(Abstract)

Increasing concentrations of heavy metals in the environment and their effects on ecosystems and biota is still an imminent threat, particularly in developing parts of the globe. The aim of the present study was to screen the heavy metal concentrations in multiple bird species across Pakistan and to preliminary evaluate the influence of taxa, trophic level, and geographical location on heavy metal accumulation in various bird species. For this purpose, we measured the concentration of 9 heavy metals (Pb, Cd, Cr, Ni, Co, Cu, Fe, Zn and Mn) in feathers of 48 bird species from different localities in Pakistan. Species exhibited heterogeneous levels of heavy metals in feathers with marked inter and intra specific variations. Mean concentrations of studied metals in feathers followed the trend Fe > Zn > Cu > Pb > Mn > Cr > Ni > Co > Cd. Species belonging to closely related taxa (families) showed comparable metal concentrations in their feathers, inferring potential phylogenetic similarities in metal exposure or accumulation. In general, concentrations of metals were greatest in carnivorous species followed by omnivorous and insectivorous birds, and granivores showing minimal levels ($p < 0.000$). Furthermore, concentrations of metals varied significantly between locations ($p < 0.000$) exhibiting highest concentrations in Punjab province and Baluchistan, probably due to higher industrial and agricultural activity and runoff, respectively. With certain limitation, influence of trophic level, taxonomic affiliation and sampling location of birds on toxic metal accumulation was also statistically corroborated through principal component analysis (PCA). This study highlights that despite restricted emissions, heavy metals persist in the local environment and may pose elevated risks for the studied bird species in Pakistan.

Threats 2014

Rahman F, Ismail A, Yusof S (in press) Metals contamination in the foraging area of Milky Stork: evidence of anthropogenic inputs in the aquatic environment of Kuala Gula, Malaysia. *Toxicological & Environmental Chemistry*.

(Abstract)

The rapid decline of the wild Milky Stork population in Malaysia has led to the reintroduction of the captive bred species in Kuala Gula, Perak. The area is known as an important migratory stopover and sanctuary for both visitors and resident birds. Although Kuala Gula and its adjacent areas are regarded as pristine and unpolluted, recent study suggested that accumulation of certain pollutants is occurring in the aquatic environment of the area. Surface sediment samples from five foraging areas considered important to the reintroduced Milky Storks have been analyzed for metals contamination. The results show that elevations of Cu, Zn, and Pb ranging from 9.7 to 57 mg/kg, 71 to 120 mg/kg, and 28 to 47 mg/kg have occurred, except for Cd (0.9–1.7 mg/kg). The accumulation of these metals is site-specific which reflects continuous anthropogenic inputs into the aquatic environment of Kuala Gula. In addition, metal levels in some areas have exceeded the effects range low values, and thus urgent action is needed to ensure good practice and sustainable management of Kuala Gula by responsible parties.

Choi, Y. R. 2014. Modernization, Development and Underdevelopment: Reclamation of Korean tidal flats, 1950s-2000s. *Ocean & Coastal Management* **102**:426-436.

(Abstract)

This paper traces South Korea's history of coastal reclamation from the 1950s until today, exploring how it emerged as the state's program for modernization and economic development and how it has played particular roles in the changing political economy of the country. The developmental state scaled up the size of reclamation practices, significantly extending construction periods and leaving enduring impacts on coastal communities and the marine environment. Large-scale coastal reclamation had been primarily and persistently sought to create agricultural land, of which particular rationales emerged and evolved as the country rapidly industrialized and saw increasing urban-rural disparities. While coastal reclamation is said to have contributed to South Korea's post-war development, it also aided the state's highly uneven spatial economic development strategies by reinforcing the conditions of underdevelopment in rural areas. It had the repeated but temporary effect of politically appeasing rural populations marginalized from sharing in the nation's growing wealth. The agricultural rationales, especially those with an emphasis on rice production, continued to be invented by major reclamation institutions to justify further reclamation. Hailed as a territorial expansion project and promoted for agricultural land conversion through the logic of virtual urban-rural land exchange, the focus of reclamation eventually shifted from rice to land production. Recently as South Korea entered into the stage of post-development, the temporal mismatch between planning and completion found in mega-scale reclamation projects has undermined the initial agricultural land rationale. However, now even land turned flexible to accommodate non-agricultural uses is lacking demand as financial investment in reclaimed land has slowed down. Today, the vacancy of the reclaimed land is actively mobilized in local regionalist politics, once again giving false promises of development to rural populations.

Tsygankov, V. Y., M. D. Boyarova, and O. N. Lukyanova. 2014. Organochlorine Pesticides in Fulmar (*Fulmarus glacialis* Linnaeus, 1761) from the Coast of Eastern Kamchatka and the Kuril Islands. *Achievements in the Life Sciences* **8**:61–64.

(Abstract)

Organochlorine pesticides are persistent toxic substances of anthropogenic origin that affect biota. Hexachlorocyclohexane (HCH) isomers (α-, β-, and γ-), DDT and its metabolites (DDD and DDE) were detected in five individuals of fulmars *Fulmarus glacialis* Linnaeus, 1761 from the coast of Eastern Kamchatka and the Kuril Islands. The average amount of HCH isomers in the organs of fulmars ranged from 608±177 ng/g lipids in the total homogenate of the organs to 2093±264 ng/g lipids in the feathers with skin. The average range of the amounts of DDT and its metabolites was from 3606 ± 333 ng/g lipids in the feathers with skin to 4076 ± 1624 ng/g lipids in the feathers. The results are discussed.

Robertson, G. J., S. G. Gilliland, P. C. Ryan, J. Dussureault, K. Power, and B. C. Turner. 2014. Mortality of Common Eider, *Somateria mollissima* (Linnaeus, 1758), and other water birds during two inshore oiling events in southeastern Newfoundland, 2005 and 2006. *Canadian Field-Naturalist* **128**: 235–242.

(Abstract)

Although the waters off Newfoundland harbour millions of wintering marine birds, chronic marine oil pollution has been repeatedly reported. Unusually high numbers (hundreds) of oiled birds were noted following two events in March 2005 and April 2006 in southeastern Newfoundland. Common Eiders (*Somateria mollissima* [Linnaeus, 1758]) were the main victims in the first event, with at least 1400 affected, based on retrieval of carcasses and aerial surveys. The April 2006 event affected 19 species; Common Eiders were again the most numerous with a minimum of 337 birds oiled. Among the Common Eiders affected in both events, most were the northern type, including the borealis (C. L. Brehm, 1824) subspecies and presumed intergrades between *borealis* and *dresseri* Sharpe, 1871. Coupled with the legal harvest, these oiling events may have had an effect on the wintering Common Eider population. Alcids, other sea ducks, loons and gulls were also oiled, but in low numbers (< 100); thus, their populations were not likely affected by these events.

Rodríguez, A., G. Burgan, P. Dann, R. E. Jessop, J. J. Negro, and A. Chiaradia. 2014. Fatal Attraction of Short-Tailed Shearwaters to Artificial Lights. *PLoS ONE* **9**: e110114.

(Abstract)

Light pollution is increasing around the world and altering natural nightscapes with potential ecological and evolutionary consequences. A severe ecological perturbation caused by artificial lights is mass mortalities of organisms, including seabird fledglings that are attracted to lights at night on their first flights to the sea. Here, we report on the number of fledging short-tailed shearwaters *Ardenna tenuirostris* found grounded in evening and morning rescue patrols conducted at Phillip Island, Australia, during a 15-year period (1999–2013). We assessed factors affecting numbers of grounded birds and mortality including date, moon phase, wind direction and speed, number of visitors and holiday periods. We also tested experimentally if birds were attracted to lights by turning the lights off on a section of the road. Of 8871 fledglings found, 39% were dead or dying. This mortality rate was 4–8 times higher than reported elsewhere for other shearwater species, probably because searching for fledglings was part of our systematic rescue effort rather than the opportunistic rescue used elsewhere. Thus, it suggests that light-induced mortality of seabirds is usually underestimated. We rescued more birds (dead and alive) in peak fledging, moonless and windy nights. Mortality increased through the fledging period, in the mornings and with increased traffic on holiday periods. Turning the road lights off decreased the number of grounded birds (dead and alive). While moon, wind and time are uncontrolled natural constraints, we demonstrated that reduction of light pollution and better traffic management can mitigate artificial light-induced mortality.

Galbraith, H., D. W. DesRochers, S. Brown, and M. Reed. 2014. Predicting Vulnerabilities of North American Shorebirds to Climate Change. *PLoS ONE* **9**: e108899.

(Abstract)

Despite an increase in conservation efforts for shorebirds, there are widespread declines of many species of North American shorebirds. We wanted to know whether these declines would be exacerbated by climate change, and whether relatively secure species might become at–risk species. Virtually all of the shorebird species breeding in the USA and Canada are migratory, which means climate change could affect extinction risk via changes on the breeding, wintering, and/or migratory refueling grounds, and that ecological synchronicities could be disrupted at multiple sites. To predict the effects of climate change on shorebird extinction risks, we created a categorical risk model complementary to that used by Partners–in–Flight and the U.S. Shorebird Conservation Plan. The model is based on anticipated changes in breeding, migration, and wintering habitat, degree of dependence on ecological synchronicities, migration distance, and degree of specialization on breeding, migration, or wintering habitat. We evaluated 49 species, and for 3 species we evaluated 2 distinct populations each, and found that 47 (90%) taxa are predicted to experience an increase in risk of extinction. No species was reclassified into a lower–risk category, although 6 species

had at least one risk factor decrease in association with climate change. The number of species that changed risk categories in our assessment is sensitive to how much of an effect of climate change is required to cause the shift, but even at its least sensitive, 20 species were at the highest risk category for extinction. Based on our results it appears that shorebirds are likely to be highly vulnerable to climate change. Finally, we discuss both how our approach can be integrated with existing risk assessments and potential future directions for predicting change in extinction risk due to climate change.

Henkel, J. R., B. J. Sigel, and C. M. Taylor. 2014. Oiling rates and condition indices of shorebirds on the northern Gulf of Mexico following the Deepwater Horizon oil spill. Journal of *Field Ornithology* ***85****: 408–420*.

(Abstract)

The coastline of the Gulf of Mexico in the United States is an important wintering and stopover region for migratory shorebirds. The Deepwater Horizon oil spill (April–August 2010) impacted more than 1700 km of this coastline and could potentially affect shorebirds through long-term exposure to toxins, degraded habitats, and altered food chains. We investigated the exposure to Deepwater Horizon oil of seven species of shorebirds that winter or stopover along the northern Gulf of Mexico. From October 2010 to May 2012, we captured and banded 691 shorebirds at six sites that experienced varying levels of oil contamination. Of birds sampled, 22 were lightly oiled, with species that forage on the coast having higher rates of oiling than those that forage in more estuarine habitats. Although only 8.6% of birds captured from October 2010 to May 2011 and 0.6% of the birds captured from August 2011 to June 2012 showed signs of oiling, an unknown, but potentially larger, number of shorebirds were likely exposed to indirect effects of the spill, such as decreased foraging time due to oiling of sites or disturbance from cleanup activities. Fuel stores and fattening rates of Dunlins (*Calidris alpina*) during spring migration, as measured using plasma metabolites, were not influenced by site oiling level. However, the level of disturbance at study sites was a significant predictor of both fuel stores and glycerol levels, suggesting that Dunlins stopping over during spring migration may have had difficulty reaching necessary fuel stores in spring 2011 due to disturbance from cleanup activity on oiled beaches. These effects from disturbance were only observed at sites with high cleanup activity, suggesting that the impact of oil-spill cleanup on shorebirds may be minimized by limiting cleanup activities to specific areas and times of day.

Lavoie, R. A., C. J. Baird, L. E. King, T. K. Kyser, V. L. Friesen, and L. M. Campbell. 2014. Contamination of Mercury during the Wintering Period Influences Concentrations at Breeding Sites in Two Migratory Piscivorous Birds. *Environmental Science and Technology* **48**: 13694−13702.

(Abstract)

Many aquatic fish-eating birds migrate long distances and are exposed to different mercury concentrations ([Hg]) during their annual cycle. Here we examined the importance of migration on [Hg] in two colonial migratory fish-eating bird species. We determined temporal trends of [Hg] and stable isotopes of carbon (δ13C) and nitrogen (δ15N) during the annual cycle in Double-crested Cormorants (*Phalacrocorax auritus*) and Caspian Terns (*Hydroprogne caspia*) breeding in Lake Ontario by a repeated sampling of breast feathers and blood from recaptured individuals. We found an effect of previous winter [Hg], species, sex, and location to explain variations of Hg at breeding sites. This suggests Hg carryover from winter to summer periods and that variations of [Hg] in the summer are partially explained by [Hg] in the winter. Carryover of Hg among seasons and slow changes in [Hg] over time were found especially for individuals in high winter exposure groups, suggesting a slow depuration rate and a fast uptake rate for both species. In contrast, stable isotope values rapidly switched to reach equilibrium at a similar midpoint regardless of winter habitat or diet suggesting minimal carryover of isotopic signatures. The potential of Hg carryover from wintering sites indicates that Hg concentrations in birds at a given time may be influenced by previous exposure from distant locations.

Fort, J., G. J. Robertson, D. Grémillet, G. Traisnel, and P. Bustamante. 2014. Spatial Ecotoxicology: Migratory Arctic Seabirds Are Exposed to Mercury Contamination While Overwintering in the Northwest Atlantic. *Environmental Science and Technology* **48**: 11560−11567.

(Abstract)

Arctic organisms are exposed to various levels of pollutants, among which mercury (Hg) has raised important environmental concerns. Previous studies examining Hg levels, trends, and effects on Arctic marine top predators have focused on the Arctic region. However, many of these top predators, such as seabirds, migrate to spend a large part of their life cycle far from the Arctic in areas where their exposure to contaminants is largely unknown. By combining biotelemetry and Hg and stable isotope analyses, we studied the seasonal Hg contamination of little auks (*Alle alle*, the most abundant Arctic seabird) in relation to their distribution and marine foraging habitat, as well as its potential impacts on bird reproduction. We show that little auks were ∼3.5 times more contaminated when outside the breeding season, and that Hg that accumulated during this nonbreeding non-Arctic period was related to egg size the following season, with females having more Hg laying smaller eggs. Our results highlight that ecotoxicological studies should be expanded to yield a comprehensive understanding of contamination risks and associated threats to top predators over their entire annual cycle. Furthermore, we show that an important nonbreeding area located in the northwest Atlantic was associated with greater Hg contamination and demonstrate the utility of bird-borne miniaturized technology for evaluating the contamination of marine systems on large spatial scales.

Kim, J., and J.-M. Oh. 2014. Concentration of trace elements in feathers of waterfowl, Korea. *Environmental Monitoring and Assessment* **186**: 8517–8525.

(Abstract)

Cadmium (Cd), lead (Pb), chromium (Cr), copper (Cu), manganese (Mn), zinc (Zn), and iron (Fe) were analyzed in the breast feather of white-fronted geese (*Anser albifrons*, n=15), mallards (*Anas platyrhynchos*, n=4), and spot-billed ducks (*Anas poecilorhyncha*, n=13) found dead in Gimpo, Korea. All of the mallards and eight of the 13 spot-billed ducks had embedded shot. Concentrations of Pb, Cr, Cu, Mn, Zn, and Fe were significantly different among waterfowl species. Mallards with embedded shot had relatively higher Pb, Cr, Mn, and Fe concentrations than the other species. Cd and Cr in feathers of waterfowl species were within the range reported for other birds, and no specimen exceeded the tentative threshold effect levels of Cd (2 μg/g dry weight (dw)) and Cr (2.8 μg/g dw) for birds. However, Pb in feathers of all four mallards and two spot-billed ducks exceeded the threshold for deleterious effects (>4 μg/g dw). Essential elements such as Cu, Mn, Zn, and Fe in the feather of waterfowl species were not at toxic levels and within the background or normal range for the homeostatic mechanisms.

Marques, A. T., H. Batalha, S. Rodrigues, H. Costa, M. J. Ramos Pereira, C. Fonseca, M. Mascarenhas, and J. Bernardino. 2014. Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies. *Biological Conservation* **179**, 40–52.

(Abstract)

Bird mortality due to collisions with wind turbines is one of the major ecological concerns associated with wind farms. Data on the factors influencing collision risk and bird fatality are sparse and lack integration. This baseline information is critical to the development and implementation of effective mitigation measures and, therefore, is considered a priority research topic. Through an extensive literature review (we compiled 217 documents and include 111 in this paper), we identify and summarize the wide range of factors influencing bird collisions with wind turbines and the available mitigation strategies. Factors contributing to collision risk are grouped according to species characteristics (morphology, sensorial perception, phenology, behavior or abundance), site (landscape, flight paths, food availability and weather) and wind farm features (turbine type and configuration, and lighting). Bird collision risk results from complex interactions between these factors. Due to this complexity, no simple formula can be broadly applied in terms of mitigation strategies. The best mitigation option may involve a combination of more than one measure, adapted to the specificities of each site, wind farm and target species. Assessments during project development and turbine curtailment during operation have been presented as promising strategies in the literature, but

need further investigation. Priority areas for future research are: (1) further development of the methodologies used to predict impacts when planning a new facility; (2) assessment of the effectiveness of existing minimization techniques; and (3) identification of new mitigation approaches.

Miller, A., J. E. Elliott, K. H. Elliott, M. F. Guigueno, L. K. Wilson, S. Lee, and A. Idrissi. 2014. Spatial and temporal trends in brominated flame retardants in seabirds from the Pacific coast of Canada. *Environmental Pollution* **195**, 48-55.

(Abstract)

Polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecane (HBCDD) are bioaccumulative flame retardants. PBDEs increased in many ecosystems during the late 20th century, but recently have declined in some environments. To examine trends in the northern Pacific, we analysed PBDEs, HBCDD and carbon and nitrogen stable isotopes (d13C and d15N) to account for dietary effects in archived eggs of three seabird species from British Columbia, Canada, 1990-2011 (rhinoceros auklets, Cerorhinca monocerata; Leach's storm-petrels, Oceanodroma leucorhoa; ancient murrelets, Synthliboramphus antiquus, 2009 only). PBDEs increased until approximately 2000 and then decreased, while HBCDD increased exponentially throughout the examined period. No significant changes in dietary tracers were observed. HBCDD and SPBDE levels varied among species; SPBDE also varied among sites. Temporal changes in contaminant concentrations are unlikely to have been caused by dietary changes, and likely reflect the build-up followed by decreases associated with voluntary phase-outs and regulations implemented in North America to control PBDEs.

Ishii, C., Y. Ikenaka, S. M. M. Nakayama, Y. Suzuki, Y. Watanuki, Y. Watanabe, Y. B. Yohannes, H. Mizukawa, and M. Ishizuka. 2014. Contamination status and accumulation characteristics of metals and a metalloid in birds on Teuri Island, Hokkaido, Japan. *Japanese Journal of Veterinary Research* **62**, 143-149.

(Abstract)

Teuri Island, Hokkaido in Japan is an important place for seabirds breeding. We measured the concentrations of heavy metals (Hg, Cd, Cr, Co, Ni, Cu, Zn, and Pb) and a metalloid (As) in rhinoceros auklet (Cerorhinca monocerata) (n = 7), thick-billed murre (Uria lomvia) (n = 2), spectacled guillemot (Cepphus carbo) (n = 6), slaty-backed gull (Larus schistisagus) (n = 15), jungle crow (Corvus macrorhynchos) (n = 3), Japanese anchovy (Engraulis japonica) (n = 6) and Atka mackerel (Pleurogrammus azonus) (n = 2). Spectacled guillemot had

high As concentrations, with its source being their feeding habitat. Concentration of Hg in kidney of jungle crow was higher than other seabird species at Teuri.

Franson, J. C., and R. E. Russell. 2014. Lead and eagles: demographic and pathological characteristics of poisoning, and exposure levels associated with other causes of mortality. *Ecotoxicology* **23**, 1722–1731.

(Abstract)

We conducted a retrospective analysis to evaluate demographic and pathologic characteristics in 484 bald eagles (Haliaeetus leucocephalus) and 68 golden eagles (Aquila chrysaetos) diagnosed with lead poisoning at the U.S. Geological Survey National Wildlife Health Center. As part of our analysis, we compared characteristics of lead poisoned eagles with those that died of other causes. Odds of lead poisoning were greater for bald eagles versus golden eagles, females versus males, adults versus juveniles, and eagles from the Mississippi and Central flyways versus the Atlantic and Pacific flyways. In addition to spatial, species, and demographic associations, we detected a distinct temporal trend in the collection date of lead poisoned bald eagle carcasses. These carcasses were found at greater frequency in late autumn and winter than spring and summer. Lesions in lead poisoned birds included emaciation, evidence of bile stasis, myocardial degeneration and necrosis, and renal tubular nephrosis and necrosis. Ingested lead ammunition or fragments were found in 14.2 % of bald eagles and 11.8 % of golden eagles. The overall mean liver lead concentration (wet weight basis) for eagles diagnosed with lead poisoning was 28.9 ± 0.69 SE mg/kg in bald eagles and 19.4 ± 1.84 SE mg/kg in golden eagles. In eagles diagnosed with collision trauma, electrocution, poisoning (other than lead), emaciation, infectious disease, trapping death, other, and undetermined causes, average liver lead concentrations were low.

Murray NJ, Clemens RS, Phinn SR, Possingham HP, Fuller RA (2014) Tracking the rapid loss of tidal wetlands in the Yellow Sea. *Frontiers in Ecology and the Environment* **12**, 267-272.

(Abstract)

In the Yellow Sea region of East Asia, tidal wetlands are the frontline ecosystem protecting a coastal population of more than 60 million people from storms and sea-level rise. However, unprecedented coastal development has led to growing concern about the status of these ecosystems. We developed a remote-sensing method to assess change over ~4000 km of the Yellow Sea coastline and discovered extensive losses of the region's principal coastal ecosystem – tidal flats – associated with urban, industrial, and agricultural land reclamations. Our analysis revealed that 28% of tidal flats existing in the 1980s had disappeared by the late 2000s (1.2% annually). Moreover, reference to historical maps suggests that up to 65% of

tidal flats were lost over the past five decades. With the region forecast to be a global hotspot of urban expansion, development of the Yellow Sea coastline should pursue a course that minimizes the loss of remaining coastal ecosystems.

Robinson BG, Franke A, Derocher AE. 2014. The Influence of Weather and Lemmings on Spatiotemporal Variation in the Abundance of Multiple Avian Guilds in the Arctic. *PLoS ONE* **9**, e101495.

(Abstract)

Climate change is occurring more rapidly in the Arctic than other places in the world, which is likely to alter the distribution and abundance of migratory birds breeding there. A warming climate can provide benefits to birds by decreasing spring snow cover, but increases in the frequency of summer rainstorms, another product of climate change, may reduce foraging opportunities for insectivorous birds. Cyclic lemming populations in the Arctic also influence bird abundance because Arctic foxes begin consuming bird eggs when lemmings decline. The complex interaction between summer temperature, precipitation, and the lemming cycle hinder our ability to predict how Arctic-breeding birds will respond to climate change. The main objective of this study was to investigate the relationship between annual variation in weather, spring snow cover, lemming abundance and spatiotemporal variation in the abundance of multiple avian guilds in a tundra ecosystem in central Nunavut, Canada: songbirds, shorebirds, gulls, loons, and geese. We spatially stratified our study area based on vegetation productivity, terrain ruggedness, and freshwater abundance, and conducted distance sampling to estimate strata-specific densities of each guild during the summers of 2010–2012. We also monitored temperature, rainfall, spring snow cover, and lemming abundance each year. Spatial variation in bird abundance matched what was expected based on previous ecological knowledge, but weather and lemming abundance also significantly influenced the abundance of some guilds. In particular, songbirds were less abundant during the cool, wet summer with moderate snow cover, and shorebirds and gulls declined with lemming abundance. The abundance of geese did not vary over time, possibly because benefits created by moderate spring snow cover were offset by increased fox predation when lemmings were scarce. Our study provides an example of a simple way to monitor the correlation between weather, spring snow cover, lemming abundance, and spatiotemporal variations in Arctic-breeding birds.

Loss SR, Will T, Marra PP. 2014. Refining Estimates of Bird Collision and Electrocution Mortality at Power Lines in the United States. *PLoS ONE* **9**, e101565.

(Abstract)

Collisions and electrocutions at power lines are thought to kill large numbers of birds in the United States annually. However, existing estimates of mortality are either speculative (for electrocution) or based on extrapolation of results from one study to all U.S. power lines (for collision). Because national-scale estimates of mortality and comparisons among threats are likely to be used for prioritizing policy and management strategies and for identifying major research needs, these estimates should be based on systematic and transparent assessment of rigorously collected data. We conducted a quantitative review that incorporated data from 14 studies meeting our inclusion criteria to estimate that between 12 and 64 million birds are killed each year at U.S. power lines, with between 8 and 57 million birds killed by collision and between 0.9 and 11.6 million birds killed by electrocution. Sensitivity analyses indicate that the majority of uncertainty in our estimates arises from variation in mortality rates across studies; this variation is due in part to the small sample of rigorously conducted studies that can be used to estimate mortality. Little information is available to quantify species-specific vulnerability to mortality at power lines; the available literature over-represents particular bird groups and habitats, and most studies only sample and present data for one or a few species. Furthermore, additional research is needed to clarify whether, to what degree, and in what regions populations of different bird species are affected by power line-related mortality. Nonetheless, our data-driven analysis suggests that the amount of bird mortality at U.S. power lines is substantial and that conservation management and policy is necessary to reduce this mortality.

Eagles-Smith CA, Ackerman JT. 2014. Mercury bioaccumulation in estuarine wetland fishes: Evaluating habitats and risk to coastal wildlife. *Environmental Pollution* **193**, 147-155.

(Abstract)

Estuaries are globally important areas for methyl-mercury bioaccumulation because of high methyl-mercury production rates and use by fish and wildlife. We measured total mercury (THg) concentrations in ten fish species from 32 wetland and open bay sites in San Francisco Bay Estuary (2005e2008). Fish THg concentrations (mg/g dry weight ± standard error) differed by up to 7.4x among estuary habitats. Concentrations were lowest in open bay (0.17 ± 0.02) and tidal wetlands (0.42 ± 0.02), and highest in managed seasonal saline wetlands (1.27 ± 0.05) and decommissioned high salinity salt ponds (1.14 ± 0.07). Mercury also differed among fishes, with Mississippi silversides (0.87 ± 0.03) having the highest and longjaw mudsuckers (0.37 ± 0.01) the lowest concentrations. Overall, 26% and 12% of fish exceeded toxicity benchmarks for fish (0.20 mg/g wet weight) and piscivorous bird (0.30 mg/g wet weight) health, respectively. Our results suggest that despite managed wetlands' limited abundance within estuaries, they may be disproportionately important habitats of Hg risk to coastal wildlife.

Daryadel E, Talaei F. 2014. Analytical Study on Threats to Wetland Ecosystems and their Solutions in the Framework of the Ramsar Convention. *International Journal of Social, Management, Economics and Business Engineering* **8**, 1970-1980.

(Abstract)

Wetlands are one of the most important ecosystems on Earth. Nevertheless, various challenges threaten these ecosystems and disrupt their ecological character. Among these, the effects of human-based threats are more devastating. Following mass degradation of wetlands during 1970s, the Ramsar Convention on Wetlands (Ramsar, Iran, 1971) was concluded to conserve wetlands of international importance and prevent destruction and degradation of such ecosystems through wise use of wetlands as a mean to achieve sustainable development in all over the world. Therefore, in this paper, efforts have been made to analyze threats to wetlands and then investigate solutions in the framework of the Ramsar Convention. Finally, in order to operate these mechanisms, this study concludes that all states should in turn make their best effort to improve and restore global wetlands through preservation of environmental standards and close contribution and also through taking joint measures with other states effectively.

Zamani-Ahmadmahmoodi R, Alahverdi M, Mirzaei R. 2014. Mercury Concentrations in Common Tern *Sterna hirundo* and Slender-billed Gull *Larus genei* from the Shadegan Marshes of Iran, in North-western Corner of the Persian Gulf. *Biol Trace Elem Res* **159**, 161–166.

(Abstract)

We examined mercury levels in several tissues of Common Terns and Slender-billed Gulls collected from Shadegan Marshes of south-western Iran. In both species, total mercury content was highest in feathers followed by liver, kidney and muscle tissue. We found a significant correlation between mercury concentrations in kidney and breast feather ($r=0.83$, $p<0.05$), breast feather and liver ($r=0.81$, $p<0.05$) as well as liver and kidney ($r=0.83$, $p<0.05$). The contaminant levels in the feathers (11.53 and 15.32 μg/g in breast feather and tail feather, respectively) of Common Terns from Shadegan Marshes are higher than those reported for other tern species from elsewhere in the world, but feather mercury of Slender-billed Gull (6.61 and 5.35 μg/g in breast feather and tail feather, respectively) was similar to those reported for gull species worldwide. Mean values for mercury in the feather of two seabird species were higher than the levels known to cause adverse effects.

Weston MA, Schlacher TA, Lynn D. 2014. Pro-Environmental Beach Driving is Uncommon and Ineffective in Reducing Disturbance to Beach-Dwelling Birds. *Environmental Management* **53**, 999-1004.

(Abstract)

Vehicles on beaches cause numerous deleterious effects to coastal wildlife. These impacts may, hypothetically, be lessened if drivers act to reduce disturbance. Since it is unknown to what extent such behavior occurs, and whether it can reduce disturbance, we quantified the behavior of drivers who encountered birds on open-coast, sandy beaches in eastern Australia and the consequent bird responses. Drivers of commercial tourist buses never slowed or altered course (''evaded birds'') to avoid disturbing birds; conversely, 34 % of drivers of private cars did evade birds. Drivers of vehicles with fishing rod holders tended (P = 0.09) to evade birds more frequently than non-fishing vehicles. Evasion, when it occurred, was modest, and did not significantly decrease the intensity of bird response or the probability of escapes on the wing. Voluntary behavioral adjustments to alleviate impacts on wildlife may be unworkable, suggesting that other solutions (e.g., beach closures) might be the only effective and feasible way to reduce disturbance to birds on ocean beaches.

Bellisario B, Cerfolli F, Nascetti G. 2014. Climate effects on the distribution of wetland habitats and connectivity in networks of migratory waterbirds. *Acta Oecologica* **58**, 5-11.

(Abstract)

The establishment and maintenance of conservation areas are among the most common measures to mitigate the loss of biodiversity. However, recent advances in conservation biology have challenged the reliability of such areas to cope with variation in climate conditions. Climate change can reshuffle the geographic distribution of species, but in many cases suitable habitats become scarce or unavailable, limiting the ability to migrate or adapt in response to modified environments. In this respect, the extent to which existing protected areas are able to compensate changes in habitat conditions to ensure the persistence of species still remains unclear. We used a spatially explicit model to measure the effects of climate change on the potential distribution of wetland habitats and connectivity of Natura 2000 sites in Italy. The effects of climate change were measured on the potential for water accumulation in a given site, as a surrogate measure for the persistence of aquatic ecosystems and their associated migratory waterbirds. Climate impacts followed a geographic trend, changing the distribution of suitable habitats for migrants and highlighting a latitudinal threshold beyond which the connectivity reaches a sudden collapse. Our findings show the relative poor reliability of most sites in dealing with changing habitat conditions and ensure the long-term connectivity, with possible consequences for the persistence of species. Although alterations of climate suitability and habitat destruction could impact critical areas for migratory waterbirds, more research is needed to evaluate all possible long-term effects on the connectivity of migratory networks.

Yuan Y, Zeng G, Liang J, Li X, Li Z, Zhang C, Huang L, Lai X, Lu L, Wu H, Yu X. 2014. Effects of landscape structure, habitat and human disturbance on birds: A case study in East Dongting Lake wetland. *Ecological Engineering* **67**, 67–75.

(Abstract)

The study of birds responded to the environmental factors will contribute to the understanding of habitat selection and biodiversity conservation. East Dongting Lake, which is an important wintering habitat and pathway for migratory birds in the East Asian-Australasian Flyway, was taken as a case study. The aims of this study were to identify: (1) whether there were any relationships between environmental variables and bird species in East Dongting Lake wetland; (2) which variable(s) could be the critical one(s) markedly correlating with the birds. We applied direct multivariate analysis combined with partial analysis to quantify the effects of environmental variables on bird species in this study. The results indicated that landscape structure (explaining 40.95% of the variation), habitat index and human disturbance (75.58%, 51.97%, respectively) were significantly associated with the bird abundance while the individual effect of habitat-level variables was more evident than the others. Among the seven chosen environmental variables, five critical variables markedly related to the richness of birds ($P < 0.05$) with the impact intensity in the order of sedge area > water area > reed area > patch density > distance to residents. No obvious indication was found in our study to prove that landscape diversity and distance to road had significant correlations with the bird species abundance. The results would provide potential insights into protecting the bird diversity and the restoration of the bird habitat in East Dongting Lake wetland.

McCormick J, St. Clair CT, Bendell LI. 2014. Concentration and partitioning of metals in intertidal biofilms: implications for metal bioavailability to shorebirds. *Ecotoxicology* **23**, 229–235.

(Abstract)

We compared zinc, copper and cadmium concentrations and the operationally defined geochemical partitioning of the three metals in sediments enriched with biofilm versus sediments without obvious biofilm present (reference) sampled from five locations within the Fraser River Delta, British Columbia, Canada. Two-way ANOVA's with site and biofilm (enriched or reference) as the two factors were applied to determine if metal concentrations or the partitioning of the metal was dependent on the two factors. Sediment enriched in biofilm contained greater amounts of aqua regia extracted zinc and copper and tended to have greater amounts of reducible cadmium as compared to reference sediments. By contrast, reference sediments had greater concentrations of easily reducible copper suggesting differences in speciation between the two sediment types. Greater concentrations of reducible

cadmium within biofilm may provide a route of contaminant exposure to shorebirds whose diet is dependent on biofilm.

Pardal S, Alves JA, Ze-Ze L, Osorino H, Rocha A, Lopes RJ, Potts PM, Amaro F, Santiago-Quesada F, Sanchez-Guzman JM, Masero JA, Alves MJ, Perez-Tris J, Ramos JA, Mendes L. 2014. Shorebird low spillover risk of mosquito-borne pathogens on Iberian wetlands. *Journal of Ornithology* **155**, 549–554.

(Abstract)

Migratory shorebirds are exposed to a wide range of pathogens along their migratory flyways, but their capacity to acquire or spread pathogens beyond endemic areas is poorly known. We focused on the spillover and acquisition of mosquito-borne pathogens such as haemosporidians and West Nile virus (WNV) on key-staging Iberian wetlands during different seasons. We screened seven shorebird species (447 individuals), and detected low haemosporidian prevalence (0.6 %). Furthermore, no WNV infections could be detected, though 6.2 % revealed antibodies against flaviviruses. Although Iberian wetlands congregate numerous shorebirds of different species and origins, the potential introduction of foreign pathogens is not a common event.

Ely CR, Franson JC. 2014. Blood lead concentrations in Alaskan tundra swans: linking breeding and wintering areas with satellite telemetry. *Ecotoxicology* **23**, 349–356.

(Abstract)

Tundra swans (*Cygnus columbianus*) like many waterfowl species are susceptible to lead (Pb) poisoning, and Pb-induced mortality has been reported from many areas of their wintering range. Little is known however about Pb levels throughout the annual cycle of tundra swans, especially during summer when birds are on remote northern breeding areas where they are less likely to be exposed to anthropogenic sources of Pb. Our objective was to document summer Pb levels in tundra swans throughout their breeding range in Alaska to determine if there were population-specific differences in blood Pb concentrations that might pose a threat to swans and to humans that may consume them. We measured blood Pb concentrations in tundra swans at five locations in Alaska, representing birds that winter in both the Pacific Flyway and Atlantic Flyway. We also marked swans at each location with satellite transmitters and coded neck bands, to identify staging and wintering sites and determine if winter site use correlated with summer Pb concentrations. Blood Pb levels were generally low (\0.2 lg/ml) in swans across all breeding areas. Pb levels were lower in cygnets than adults, suggesting that swans were likely exposed to Pb on wintering areas or on return migration to Alaska, rather than on the summer breeding grounds. Blood Pb levels varied significantly across the five

breeding areas, with highest concentrations in birds on the North Slope of Alaska (wintering in the Atlantic Flyway), and lowest in birds from the lower Alaska Peninsula that rarely migrate south for winter.

Anderson B, Phillips B, Hunt J, Siegler K, Voorhees J, Smalling K, Kuivila K, Hamilton M, Ranasinghe JA, Tjeerdema R. 2014. Impacts of pesticides in a Central California estuary. *Environmental Monitoring and Assessment* **186**, 1801–1814.

(Abstract)

Recent and past studies have documented the prevalence of pyrethroid and organophosphate pesticides in urban and agricultural watersheds in California. While toxic concentrations of these pesticides have been found in freshwater systems, there has been little research into their impacts in marine receiving waters. Our study investigated pesticide impacts in the Santa Maria River estuary, which provides critical habitat to numerous aquatic, terrestrial, and avian species on the central California coast. Runoff from irrigated agriculture constitutes a significant portion of Santa Maria River flow during most of the year, and a number of studies have documented pesticide occurrence and biological impacts in this watershed. Our study extended into the Santa Maria watershed coastal zone and measured pesticide concentrations throughout the estuary, including the water column and sediments. Biological effects were measured at the organism and community levels. Results of this study suggest the Santa Maria River estuary is impacted by current-use pesticides. The majority of water samples were highly toxic to invertebrates (*Ceriodaphnia dubia* and *Hyalella azteca*), and chemistry evidence suggests toxicity was associated with the organophosphate pesticide chlorpyrifos, pyrethroid pesticides, or mixtures of both classes of pesticides. A high percentage of sediment samples were also toxic in this estuary, and sediment toxicity occurred when mixtures of chlorpyrifos and pyrethroid pesticides exceeded established toxicity thresholds. Based on a Relative Benthic Index, Santa Maria estuary stations where benthic macroinvertebrate communities were assessed were degraded. Impacts in the Santa Maria River estuary were likely due to the proximity of this system to Orcutt Creek, the tributary which accounts for most of the flow to the lower Santa Maria River. Water and sediment samples from Orcutt Creek were highly toxic to invertebrates due to mixtures of the same pesticides measured in the estuary. This study suggests that the same pyrethroid and organophosphate pesticides that have been shown to cause water and sediment toxicity in urban and agriculture water bodies throughout California, have the potential to affect estuarine habitats. The results establish baseline data in the Santa Maria River estuary to allow evaluation of ecosystem improvement as management initiatives to reduce pesticide runoff are implemented in this watershed.

Li L, Jiang Z. 2014. International Trade of CITES Listed Bird Species in China. *PLoS ONE* **9**, e85012.

(Abstract)

Commercial trade of wild birds may devastate wild bird populations. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) controls the trade of wild species listed in its appendices to avoid these species being threatened by international trade. China used to be one of the major trading countries with significant bird trade with foreign countries; on the other hand, China is a country with unique avian fauna, many Important Bird Areas and critically endangered bird species. What is the role of the country in world wild bird trade? What kind of insights can we extract from trade records for improving future management of wild bird trade in the country? We retrieved and analyzed international trade records of the CITES listed bird species of China from 1981 to 2010 from the CITES Trade Database maintained by United Nations Environment Program and World Conservation Monitoring Centre (UNEP-WCMC). We found that: (1) International trade of live birds in China peaked during the late 1990s, then decreased to the level before the surge of trade in a few years, the trade dynamics of wild birds may be affected by governmental policy and the outbreak of avian influenza during the period. (2) Most frequently traded CITES Appendix listed birds in China were parrots, most of which were exotic species to the country. (3) Birds were mainly traded for commercial purpose. Exotic birds in trade were mainly captive-bred while the most Chinese birds traded internationally were captured from the wild. Since many bird species in international trade are threatened to extinction, China should take stricter measures on importing of wild-captured birds and should collaborate with the countries of original in the international bird trade to avoid unsustainable harvesting of wild birds. It is urgent for China to carry out population surveys on those domestic bird species once in significant international trade and to make better conservation decisions based on population status of those birds. In addition, more scientific researchers should be encouraged to participate in the wildlife trade management to avoid misreporting trade data or biased analyses of the trade records.

Wilson JD, Anderson R, Bailey S, Chetcuti J, Cowie NR, Hancock MH, Quine CP, Russell N, Stephen LS, Thompson DBA (2014) Modelling edge effects of mature forest plantations on peatland waders informs landscape-scale conservation. *Journal of Applied Ecology* **51**, 204–213.

(Abstract)

1. Edge effects of native forest fragmentation have been well studied, but there are few studies of open-ground habitats fragmented by plantation forests. We measure forestry edge effects on open-ground breeding birds, following one of Europe's biggest and most controversial land-use transformations.

2. The 'Flow Country' of northern Scotland is one of the world's greatest expanses of blanket bog. It became fragmented by conifer forests planted in the late 20th century, and these now

adjoin open peatlands protected under European conservation legislation. Detrimental edge effects on breeding birds were anticipated, but not apparent shortly after planting.

3. Using survey data collected in 2003–2006, and logistic regression modelling, we tested whether breeding distributions of three wader species of international conservation concern, dunlin, European golden plover and common greenshank, were influenced by distance to forest edge, controlling for habitat and topography.

4. All three species were more likely to occupy flatter, more exposed ground close to bog pools and were influenced by peatland vegetation structure. There was an additive and adverse effect of proximity to forest edge for dunlin and European golden plover, but not common greenshank. This effect was strongest within 700 m of forest edges. We used these results to predict which areas should benefit most from removal of adjacent forestry and so guide maintenance and restoration of the bird interests of the protected areas.

5. Synthesis and applications. Edge effects of mature forestry on dunlin and golden plover are apparent over several hundred metres and are now being used to guide forest planning in northern Scotland. The scale of edge effect is broadly consistent with other avian studies in open-ground habitats across Eurasia and North America, so buffer zones of this order are consistent with possible impacts of plantation forestry on open-ground habitats of bird conservation interest. Given renewed interest in conifer afforestation as a climate change mitigation measure, an improved understanding of edge effects and the mechanisms through which they operate is vital to managing plantation forestry in ways that maintain open-ground landscapes of high conservation value.

Koch SL, Paton PWC. 2014. Assessing Anthropogenic Disturbances to Develop Buffer Zones for Shorebirds Using a Stopover Site. *The Journal of Wildlife Management* **78**, 58–67.

(Abstract)

Calidris sandpipers generally allowed pedestrians to approach within 25 m before flushing, whereas larger shorebirds (black-bellied plover [*Pluvialis squatarola*] and American oystercatcher [*Haematopus palliatus*]) had FID over 50m. We also found that juveniles of all species had shorter FID than adults. Based on adult FID, we developed species-specific buffer distances for 11 species that ranged from 61 m for least sandpiper (*Calidris minutilla*) to 186 m for black-bellied plover. We also investigated the potential impacts of commercial and recreational shellfish harvesters, who rake for soft shell clams (*Mya arenaria*) on mudflats where shorebirds actively foraged. Microhabitats with recent shellfishing activity had a positive influence on the density of 2 species (ruddy turnstone [*Arenaria interpres*], and American oystercatcher), whereas the presence of shellfishers did not appear to affect the density of other species of shorebird we monitored. We regularly detected black-bellied plovers and ruddy turnstones actively foraging in microhabitats where shellfishers had recently exposed sediment. Given the levels of shellfishing and pedestrian traffic at Monomoy Refuge, we found no evidence to suggest that current human activity has a strong negative impact on migratory shorebirds using Monomoy Refuge. However, if the amount of pedestrian traffic and

shellfishing were to increase substantially, a buffer zone system might have to be implemented during peak migration periods to minimize impacts, with buffers >185m from key foraging sites to reduce disturbance to the most sensitive species.

Loss SR, Will T, Loss SS, Marra PP. 2014. Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. *The Condor* **116**, 8-23.

(Abstract)

Building collisions, and particularly collisions with windows, are a major anthropogenic threat to birds, with rough estimates of between 100 million and 1 billion birds killed annually in the United States. However, no current U.S. estimates are based on systematic analysis of multiple data sources. We reviewed the published literature and acquired unpublished datasets to systematically quantify bird–building collision mortality and species-specific vulnerability. Based on 23 studies, we estimate that between 365 and 988 million birds (median ¼ 599 million) are killed annually by building collisions in the U.S., with roughly 56% of mortality at low-rises, 44% at residences, and <1% at high-rises. Based on >92,000 fatality records, and after controlling for population abundance and range overlap with study sites, we identified several species that are disproportionately vulnerable to collisions at all building types. In addition, several species listed as national Birds of Conservation Concern due to their declining populations were identified to be highly vulnerable to building collisions, including Golden-winged Warbler (*Vermivora chrysoptera*), Painted Bunting (*Passerina ciris*), Canada Warbler (*Cardellina canadensis*), Wood Thrush (*Hylocichla mustelina*), Kentucky Warbler (*Geothlypis formosa*), and Worm-eating Warbler (*Helmitheros vermivorum*). The identification of these five migratory species with geographic ranges limited to eastern and central North America reflects seasonal and regional biases in the currently available building-collision data. Most sampling has occurred during migration and in the eastern U.S. Further research across seasons and in underrepresented regions is needed to reduce this bias. Nonetheless, we provide quantitative evidence to support the conclusion that building collisions are second only to feral and free-ranging pet cats, which are estimated to kill roughly four times as many birds each year, as the largest source of direct human-caused mortality for U.S. birds.

Johnston A, Cook ASCP, Wright LJ, Humphreys EM, Burton NHK. 2014. Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. *Journal of Applied Ecology* **51**, 31–41.

(Abstract)

1. The number of offshore wind farms is rapidly increasing as they are a critical part of many countries' renewable energy strategies. Quantifying the likely impacts of these developments on wildlife is a fundamental part of the impact assessments required in many regions before permission for developments is granted. A key concern related to wind turbines is the risk of birds colliding with turbine blades. We present a novel method to generate species-specific flight height distributions which can be used to improve the assessment of collision risk by better reflecting the proportion of in-flight populations at risk of collision.

2. Data describing the flight heights of birds from surveys of 32 potential offshore wind farm development sites were combined to estimate continuous distributions for 25 marine bird species. Observations of flying birds assigned to discrete height categories were treated as observations from independent multinomial distributions with a shared underlying continuous distribution. This analysis enables calculation of the uncertainty around the estimates of the proportion of the in-flight population at risk and consideration of different turbine designs.

3. The mean r^2 for model fit across species was 0.85, and for seven of the species, good independent model validation (80% of independent observations within 95% confidence intervals) provides some confidence for use of the results at alternative sites.

4. All species exhibited positively skewed flight height distributions. These results demonstrate that under the conditions in which the data were collected, raising hub height and using fewer, larger turbines are effective measures for reducing collision risk.

5. Synthesis and applications. The methods presented here for modelling continuous flight height distributions provide measures of uncertainty and enable comparison of collision risk between different turbine designs. This approach will improve the accuracy of impact assessments and provide estimates of uncertainty, allowing better evidence to inform decision making.

Vickery JA, Ewing SR, Smith KW, Pain DJ, Bairlein F, Skorpilov J, Gregory RD. 2014. The decline of Afro-Palaearctic migrants and an assessment of potential causes. *Ibis* **156**, 1–22.

(Abstract)

There is compelling evidence that Afro-Palaearctic (A-P) migrant bird populations have declined in Europe in recent decades, often to a greater degree than resident or short-distance migrants. There appear to have been two phases of decline. The first in the 1960s–1970s, and in some cases into the early 1980s, largely affected species wintering predominantly in the arid Sahelian zone, and the second since the 1980s has mostly affected species wintering in the humid tropics and Guinea forest zone. Potential drivers of these declines are diverse and are spread across and interact within the migratory cycle. Our knowledge of declining species is generally better for the breeding than the non-breeding parts of their life cycles, but there are significant gaps in both for many species. On the breeding grounds, degradation of breeding habitats is the factor affecting the demography of the largest number of species, particularly within agricultural systems and woodland and forests. In the non-breeding areas,

the interacting factors of anthropogenic habitat degradation and climatic conditions, particularly drought in the Sahel zone, appear to be the most important factors. Based on our synthesis of existing information, we suggest four priorities for further research: (1) use of new and emerging tracking technologies to identify migratory pathway and strategies, understand migratory connectivity and enable field research to be targeted more effectively; (2) undertake detailed field studies in sub-Saharan Africa and at staging sites, where we understand little about distribution patterns, habitat use and foraging ecology; (3) make better use of the wealth of data from the European breeding grounds to explore spatial and temporal patterns in demographic parameters and relate these to migratory pathways and large-scale patterns of habitat change and climatic factors; and (4) make better use of remote sensing to improve our understanding of how and where land cover is changing across these extensive areas and how this impacts A-P migrants. This research needs to inform and underpin a flyway approach to conservation, evaluating a suite of drivers across the migratory cycle and combining this with an understanding of land management practices that integrate the needs of birds and people in these areas.

Gao X, Zhou F, Chen C-TA. 2014. Pollution status of the Bohai Sea: An overview of the environmental quality assessment related trace metals. *Environment International* **62**, 12–30.

(Abstract)

It is well recognized that the ecosystem of the Bohai Sea is being rapidly degraded and the Sea has basically lost its function as a fishing ground. Billions of funds have been spent in slowing down, halting and finally reversing the environmental deterioration of the Bohai Sea. Although trace metals are routinely monitored, the data with high temporal resolution for a clear understanding of biogeochemical processes in the ecosystem of the Bohai Sea are insufficient, especially in the western literature. In this review, status of trace metal contamination in the Bohai Sea is assessed based on a comprehensive review of their concentrations recorded in the waters, sediments and organisms over the past decades. Studies show that metal contamination in the Bohai Sea is closely associated with the fast economic growth in the past decades. Concentrations of trace metals are high in coastal areas especially in the estuaries. Alarmingly high metal concentrations are observed in the waters, sediments and organisms from the western Bohai Bay and the northern Liaodong Bay, especially the coasts near Huludao in the northernmost area of the Bohai Sea, which is being polluted by industrial sewage from the surrounding areas. The knowledge of the speciation and fractionation of trace metals and the influence of submarine groundwater discharge on the biogeochemistry of trace metals in the Bohai Sea is far from enough and related work needs to be done urgently to get a better understanding of the influence of trace metals on the ecosystem of the Bohai Sea. A clear understanding of the trace metal pollution status of the Bohai Sea could not be achieved presently for lack of systematic cooperation in different research fields. It is quite necessary to apply the environmental and ecological modeling to the investigation of trace metals in the Bohai Sea and then provide foundations for the protection of the environment and ecosystem of the Bohai Sea.

Mateo R, Vallverdú-Coll N, López-Antia A, Taggart MA, Martínez-Haroa M, Guitart R, Ortiz-Santaliestra ME. 2014. Reducing Pb poisoning in birds and Pb exposure in game meat consumers: The dual benefit of effective Pb shot regulation. *Environment International* **63**, 163–168.

(Abstract)

The use of lead (Pb) ammunition in the form of shot pellets has been identified as a Pb exposure risk in wildlife and their human consumers. We explore the hypothesis that Pb shot ban enforcement reduces the risk of avian Pb poisoning as well as Pb exposure in game meat consumers. We assessed compliance with a partial ban on Pb shot commencing in 2003 by examination of 937 waterbirds harvested by hunters between 2007 and 2012 in the Ebro delta (Spain). Prevalence of Pb shot ingestion was determined, as were Pb concentrations in liver and muscle tissue to evaluate the potential for Pb exposure in game meat consumers. Hunted birds with only embedded Pb shot (no steel) declined from 26.9% in 2007–08 to b2% over the following three hunting seasons after ban reinforcement. Pb shot ingestion in mallards decreased from a pre-ban value of 30.2% to 15.5% in the post-ban period. Liver Pb levels were predominantly defined by the presence of ingested shot, whereas muscle levels were defined by the presence of both ingested and embedded shot. Only 2.5% of mallard muscle tissue had Pb levels above European Union regulations for meat (0.1 μg/g wet weight) in the 2008–09 season, when Pb shot ingestion prevalence was also at a minimum (5.1%). Effective restrictions in Pb ammunition use have a dual benefit since this reduces Pb exposure for game meat consumers due to embedded ammunition as well as reducing Pb poisoning in waterbirds.

Threats 2013

local participants through an open access website from February 2010 to March 2012. A total of Hong, S., J. Lee, Y. C. Jang, Y. J. Kim, H. J. Kim, D. Han, S. H. Hong, D. Kang, and W. J. Shim. 2013. Impacts of marine debris on wild animals in the coastal area of Korea. *Marine Pollution Bulletin***66**, 117–124.

(Abstract)

Over the last decade, marine debris has become a major factor affecting the coastal ecosystem of Korea. This study compiled information regarding how marine debris impacts wildlife in Korea. Cases of marine debris impacting wildlife were collected from experts of various fields and from 21 species were affected by marine debris: 18 species of birds, 2 species of mammals, and 1 species of crustacean. Five threatened or protected species were

identified: black-faced spoonbill, finless porpoise, water deer, whooper swan, and greater painted snipe. Recreational fishing gears were the types of debris that most frequently impacted wildlife, especially birds. Black tailed gulls were the most vulnerable species to recreational fishing hooks and lines. Although it was preliminary, this study revealed that recreational fishing activities should be prioritized when managing marine debris in Korea.

Pearce-Higgins JW, Holt CA. 2013. Impacts of climate change on waterbirds. *Marine Climate Change Impacts Partnership: Science Review*, 149-154.

(Abstract)

• There is increasing evidence that the overwintering distributions of many coastal waders have shifted in recent decades in response to warming. In the last decade, this has resulted in declines in usage of east coast sites in favour of The Netherlands, although during recent cold winters, this trend has been partially reversed.

• These changes have probably resulted from a redistribution of individuals rather than changes in survival, either in response to an altered tendency towards cold-weather movements or changing juvenile settlement patterns.

• There is increasing evidence that similar distribution changes have occurred in seaduck, which may be taking advantage of ice-free conditions in the Baltic, and coastal wintering waterfowl.

• Little egret has become much more common on estuaries in winter in response to the increasing breeding population. Projected future increases in great white egret, cattle egret and glossy ibis populations are likely to mean they are also likely to become regular users of British estuaries in winter.

• Models project future increases in the abundance of many wintering wader and waterbird populations in the UK in response to projected warming, although some are projected to decline. Most current SPAs are likely to continue to support internationally important numbers of wintering waterbirds, even under a high-emissions 2080 scenario.

• Potential changes in sea-level may alter estuarine sediment patterns, with likely impacts on wintering waterbird communities, particularly at sites where coastal defences are maintained.

• Significant warming is projected to reduce the Arctic and subarctic breeding ranges of wintering waterbirds by about 50 % by the end of the century. This suggests that despite improving winter conditions in the UK, wintering populations of many species here may decline.

Johnson CK, Kelly TR, Rideout BA. 2013. Lead in Ammunition: A Persistent Threat to Health and Conservation. *EcoHealth* **10**, 455–464.

(Abstract)

Many scavenging bird populations have experienced abrupt declines across the globe, and intensive recovery activities have been necessary to sustain several species, including the critically endangered California condor (*Gymnogyps californianus*). Exposure to lead from lead-based ammunition is widespread in condors and lead toxicosis presents an immediate threat to condor recovery, accounting for the highest proportion of adult mortality. Lead contamination of carcasses across the landscape remains a serious threat to the health and sustainability of scavenging birds, and here we summarize recent evidence for exposure to lead-based ammunition and health implications across many species. California condors and other scavenging species are sensitive indicators of the occurrence of lead contaminated carcasses in the environment. Transdisciplinary science-based approaches have been critical to managing lead exposure in California condors and paving the way for use of non-lead ammunition in California. Similar transdisciplinary approaches are now needed to translate the science informing on this issue and establish education and outreach efforts that focus on concerns brought forth by key stakeholders.

McCloskey M, Robinson S, Smith PA, Forbes M. 2013. Mercury concentration in the eggs of four Canadian Arctic-breeding shorebirds not predicted based on their population statuses. *SpringerPlus* **2**, 567.

(Abstract)

Methylmercury is a toxic form of mercury which persists in food webs for long periods of time and biomagnifies up successive trophic levels. Shorebirds breeding in the Arctic are exposed to methylmercury, derived from both natural and anthropogenic sources, when they ingest their invertebrate prey. Populations of many shorebird species are believed to be declining and one hypothesis for these declines is that they are due to detrimental effects of contaminants, including methylmercury. To test this hypothesis, we assessed mercury contamination in eggs of four Canadian Arctic-breeding shorebird species: black-bellied plover (*Pluvialis squatarola*), ruddy turnstone (*Arenaria interpres*), semipalmated plover (*Charadrius semipalmatus*) and white-rumped sandpiper (*Calidris fuscicollis*). Black-bellied plovers and ruddy turnstones are declining in the western hemisphere, whereas white-rumped sandpipers and semipalmated plovers have stable or slightly increasing populations. We found no relationship between egg mercury concentration and population trend for these four shorebird species. Intraspecific variation in mercury concentration was high. Notably, the mercury concentrations were much higher than levels found in a previous study of eggs of the same shorebird species from this same site, suggesting that mercury contamination may be subject to substantial inter-annual variation in the Canadian Arctic food web.

Mead A, Griffiths CL, Branch GM, McQuaid CD, Blamey LK, Bolton JJ, Anderson RJ, Dufois F, Rouault M, Froneman PW, Whitfield AK, Harris LR, Nel R, Pillay D, Adams JB. 2013. Human-mediated drivers of change — impacts on coastal ecosystems and marine biota of South Africa. *African Journal of Marine Science* **35**, 403–425.

(Abstract)

Coastal ecosystems are highly vulnerable to human-mediated drivers of global change because they are located at the land–ocean interface and often host centres of urbanisation and development. The South African coastline comprises several distinct coastal ecoregions that support a wide range of coastal (inshore) ecosystems, including rocky, sandy and mixed shores, kelp beds, estuaries and seagrass communities. A growing body of evidence indicates that local air and sea temperatures, wind patterns, ocean current speed and upwelling regimes are all being affected by human-mediated climate change. In addition, anthropogenic activities, such as shipping (introducing coastal bioinvasives), exploitation of coastal marine resources, industry (releasing pollutants) and urban development, act synergistically with climate change to place pressure on coastal ecosystems and their biota. The aim of this review was primarily to synthesise and update research into causes of direct and indirect human-mediated global change and their effects on South African coastal systems. It incorporates both historic and the latest regional research on climate change and anthropogenic threats across the ecosystems listed above, much of which was supported by the South African Network for Coastal and Oceanic Research (SANCOR), specifically the SEAChange programme in recent years. It is evident that all these ecosystems are vulnerable to all the drivers considered, albeit to differing degrees, depending on their location on the coast. Whereas some bioinvasives have had a dramatic impact on rocky shore systems on the West Coast, their impact has been moderate on the South Coast and minimal on the East Coast; exploitation shows the reverse pattern. Furthermore, the impacts of human-mediated drivers on coastal ecosystems are synergistic. Of major interest is the fact that the West Coast and parts of the South Coast are exhibiting cooling trends in offshore sea surface temperatures, rather than warming. Correspondingly, a geographical spread of organisms associated with West and South-West Coast rocky shores and kelp beds has tended to be eastwards around Cape Point, rather than northwards along the West Coast as would have been expected with warming sea temperatures. Overall, significant progress has been made toward a better understanding of the combined pressures on each ecosystem and knowledge gaps have been identified, thus helping to direct future research themes.

Fort J, Moe B, Strøm H, Gremillet D, Welcker J, Schultner J, Jerstad K, Johansen KL, Phillips RA, Mosbech A. 2013. Multicolony tracking reveals potential threats to little auks wintering in the North Atlantic from marine pollution and shrinking sea ice cover. *Diversity and Distributions* **19**, 1322–1332.

(Abstract)

Aim: Extensive development of human activities in combination with ocean warming is rapidly modifying marine habitats in the Arctic and North Atlantic regions. To understand the potential impacts on marine biodiversity, there is an urgent need to determine distributions and habitat preferences of potentially vulnerable species and to identify sensitive hotspots that might require particular protection. Our aims were to track one of the most abundant seabirds of the world, the little auk (*Alle alle*), to provide a large, meta-population scale overview of its non-breeding distribution and to document potential threats to this species from human activities and other environmental changes.

Location: Arctic North Atlantic.

Methods: Using light-level geolocators, we investigated the 2010/11 nonbreeding distribution of 65 little auks from four major colonies distributed throughout the Arctic North Atlantic. Bird distribution during the moulting, wintering and pre-breeding periods was compared with (1) the extent of the marginal ice zone and (2) the areas covered by the main shipping lanes and oil and gas activity licences.

Results: We identify several hotspots for this species, including two key areas located in the Greenland Sea and off Newfoundland. Crucially, we show that some of these hotspots overlap extensively with areas of intensive human activities, including oil and gas extraction and shipping. As little auks, which spend the major part of their time on the sea surface, are extremely vulnerable to marine pollution, our results emphasize the risk associated with the projected expansion of these activities.

Main conclusions: We conclude that management of further human enterprises in the Arctic needs to be based on more thorough risk assessment, requiring a substantial improvement in our knowledge of the distribution of sensitive species.

Liu Y, Huang H, Qiu Z, Fan J. 2013. Detecting coastline change from satellite images based on beach slope estimation in a tidal flat. *International Journal of Applied Earth Observation and Geoinformation* **23**, 165–176.

(Abstract)

Beach heights and tidal variation have large impacts on the accuracy of estimates of coastline position and its historical changes of a wider and flatter beach based on remote sensing data. This study presents an approach to analysis of waterline movement based on the beach slope, estimated from two effective images with Landsat images data. Two images acquired at different stages of the tide were processed to delineate accurately the position of the waterline. Then waterlines were assigned heights using elevations predicted by a two-dimensional non-linear tidal assimilation model. Beach slope can be calculated piecewise using the heighted shorelines based on the equiangular triangle theory. The positions of the national tidal height datum coastline can be obtained by the beach slope calculation method to accurately monitor

the changing of coastline. A change in the coastline of the southwest tidal flat of the Yellow River delta, from Tianshuigou to the Xiaoqing River mouth, was detected by combining field measurements of profiles and bathymetric data. The root mean squared error (RMSE) of the calculated slope of the intertidal zone was one order of magnitude less than the measured slope. The minimum error of self-consistency check is 0.2%. The RMSE between the coastlines estimated by the proposed method and those surveyed data varies from 53.98 m to 217.72 m. It is shown that this method is more suitable for the two years and over the time scales of shoreline change monitoring. To assess erosion/accretion patterns in the tidal flat, and the controlling factors, the volume of the beach was investigated as a possible indicator. The accepted coastline position and changes in the beach volume were used to monitor the changing pattern of accretion and erosion along the coast southwest of the recent Yellow River mouth.

Burger J, Niles L. 2013. Shorebirds and stakeholders: Effects of beach closure and human activities on shorebirds at a New Jersey coastal beach. *Urban Ecosystems* **16**, 657-673.

(Abstract)

Coastal habitats are critical for conservation of migrant shorebirds. We examined the effect of beach closure on recreationists and on shorebirds, at an important southbound stopover area for shorebirds at Brigantine, New Jersey. The study had three prongs: 1) involve stakeholders during all phases, 2) assess public use of the beach and responses to closure, and 3) assess shorebird use of the beach and response to closure. Stakeholders were involved in the design, implementation and evaluation of the project. The beach was used for fishing, walking, dog-walking, and other recreational activities. Sixty percent of recreationists were positive about the study and beach closure to protect shorebirds. The data indicate that: 1) involving a wide range of stakeholders early and often was important to our ability to conduct, design, and implement the study, 2) the beach was used by different types of recreationists 3) beach users were supportive of the closure, 4) spatial use by shorebirds depended upon whether the beach was open or closed, especially for red knot, and 5) all species of shorebirds used a small beach area behind a protective fence whether the beach was open or closed. Red knot behavior was most affected by beach closure; they spread out over the entire beach when it was closed, and concentrated at the tip when it was open. Conservation measures should take into account stakeholders views, human uses, beach physiognomy, and potential closure of refuge areas during critical migration times for shorebirds.

Saalfeld ST, Hill BL, Lanctot RB. 2013. Shorebird Responses to Construction and Operation of a Landfill on the Arctic Coastal Plain. *The Condor* **115**, 816-829.

(Abstract)

Although much of the Arctic Coastal Plain has remained undeveloped, oil and gas industries, new and expanding villages, as well as tourism are likely to increase in the near future. One potential effect of increased human development is increased anthropogenic waste and the need to dispose of this waste in landfills. We investigated potential indirect effects of the North Slope Borough landfill on breeding shorebirds by examining changes in environmental conditions (predator densities and timing of snow melt) and measures of shorebird reproduction (nest-initiation dates, nest density, nest survival, and return rates) in relation to construction and deposition of waste in the landfill. This study included one year of pre-construction data (2004), three years when landfill roads and fences were being constructed (2005–2007), and five years when waste was being deposited (2008–2012). We monitored 364 shorebird nests within a 36-ha plot (approximately half of which was inside the landfill and half outside). Construction of a fence around the landfill reduced snow levels inside the landfill, leading to earlier snow melt and likely to shorebirds initiating nests earlier. Densities of avian predators increased following waste deposition, but nest densities, nest survival, and return rates were generally greater inside the landfill than outside in all years after landfill construction. Our results indicate that fences placed around landfills and procedures to reduce attraction of predators to landfills can minimize indirect negative effects of landfill construction and operation and even favor species breeding in the area.

Grodsky SM, Jennelle CS, Drake D. 2013. Bird Mortality at a Wind-Energy Facility Near a Wetland of International Importance. *The Condor* **115**, 700-711.

(Abstract)

Wind turbines provide a source of renewable energy to meet increasing human demand and offset the costs of fossil fuel usage and nuclear power generation. Birds are killed and displaced at wind facilities, so increased understanding of the drivers of mortality and displacement will assist planners considering the future placement and use of wind facilities. Our objectives were to assess the effect on birds of a wind facility in southeastern Wisconsin by (1) recording the species composition of recovered bird carcasses, (2) estimating mortality rates, and (3) identifying variables correlated with fatalities. We found 20 bird carcasses during scheduled searches. On this basis, we estimated that over two springs and two autumns of study from 2008 to 2010, 607 birds (0.026 per turbine per day, 0.017 per megawatt per day) were killed over 277 days of searching at this facility containing 86 turbines. Nocturnally migrating passerines accounted for 50% of the birds found killed. We found a significant negative relationship between bird fatalities and northward movement of birds through the wind facility. Despite the close proximity of Horicon Marsh National Wildlife Refuge, a wetland of international importance, we found no relationship between distance to Horicon Marsh and bird fatalities. Our study provides a timely assessment of fatal bird collisions with turbines at a wind facility in agricultural lands, uniquely located near a large wetland at which migrating birds stage.

Bellebaum J, Korner-Nievergelt F, Dürr T, Mammend U. 2013. Wind turbine fatalities approach a level of concern in a raptor population. *Journal for Nature Conservation* **21**, 394-400.

(Abstract)

Mortality from collisions with increasing numbers of wind turbines is a potential hazard to raptor populations, but the actual effects on a population scale have rarely been studied based on field data. We estimated annual collision numbers for Red Kites *Milvus milvus* in the German federal state of Brandenburg (29,483 km^2). A hierarchical model considering carcass persistence rate, searcher efficiency and the probability that a killed animal falls into a searched area was applied to results of carcass searches at 617 turbines. Collision risk varied significantly with season. The model estimated 308 (95% CrI 159–488) Red Kite fatalities at 3044 turbines operating during 2012, representing 3.1% of the estimated post-breeding population of 9972 individuals. Using the potential biological removal (PBR) method, mortality thresholds of 4.0% were obtained for migratory Red Kite populations. This level of mortality may be reached when turbine numbers increase within a few years. Since wind turbine collisions may affect Red Kites throughout the global range, a more detailed assessment of the actual impacts on populations is needed, especially because the PBR does not account for the predominance of adult birds among the collision victims.

Kim M, Park K, Park JY, Kwak I-S. 2013. Heavy metal contamination and metallothionein mRNA in blood and feathers of Black-tailed gulls (*Larus crassirostris*) from South Korea. Environmental Monitoring and Assessment 185, 2221–2230.

(Abstract)

The objectives of this study were to determine levels of heavy metal in the feathers and blood of Black-tailed gulls (*Larus crassirostris*), to evaluate metallothionein (MT) mRNA level in Black-tailed gulls on three independent islets, and to examine the correlation between heavy metal concentrations and MT mRNA expression. Eleven heavy metals (Al, Cd, Mn, Pb, Cr, Fe, Cu, Zn, Se, Hg, and As) were investigated in blood and feathers of 65 chicks from breeding colonies (Seomando, Hongdo, and Dokdo islet) of South Korea in 2010. Heavy metals were assayed by PerkinElmer NexION 300 inductively coupled plasma mass spectrometry. The mean concentrations of nonessential heavy metals were found to blood containing Cd (0.002~0.02 ppm), Pb (0.06~0.18) ppm, Hg (0.03~ 0.05) ppm, and As (0.26~0.48 ppm), and feather containing Cd (0.05~0.30 ppm), Pb (2.47~10.80 ppm), Hg (1.18~1.57 ppm), and As (0.15~0.44 ppm). Chicks on Seomando islet showed the highest levels ofmetals (Cd, Pb,Mn, Cr, Cu, and Se in blood; Al, As,Mn, Cr, Fe, Cu, and Se in feathers) among the colonies. Concentrations of Pb and Hg in feathers were the highest on Hongdo, and the levels of Cd

and Zn in feathers were the highest on Dokdo islet. MT mRNA in the blood of Black-tailed gulls was relatively higher in gulls from Seomando than in gulls from Hongdo and Dokdo islet. MT mRNA level is thus positively correlated to heavy metal concentrations in Black-tailed gulls.

N, Brabant R, Stienen E, Courtens W, Onkelinx T, Van de walle M, Verstraete H, Vigin L, Degraer S. 2013. Bird monitoring at the Belgian offshore wind farms: results after five years of impact assessment. In 'Environmental impacts of offshore wind farms in the Belgian part of the North Sea: Learning from the past to optimise future monitoring programmes.'. (Eds S Degraer, R Brabant and B Rumes) pp. 49-61. (Royal Belgian Institute of Natural Sciences (RBINS), Operational Directorate Natural Environment, Marine Ecology and Management Section: Brussels)

(Abstract)

To monitor the impact on birds following the construction of two offshore wind farms in the Belgian part of the North Sea, a twofold strategy was followed. Monthly ship-based seabird surveys allowed for a detailed displacement effect assessment, while radar research aimed at studying avoidance behaviour and barrier effects. Both methods provided input data for collision risk modelling in order to assess bird collision rates. Three years after the completion of the wind farm at the Bligh Bank, it showed that northern gannet, common guillemot and razorbill avoid the wind farm, while numbers of lesser black-backed and herring gull increased significantly. Collision risk modelling learned that gulls in particular are at risk of colliding with the turbine blades, with up to 2.4 bird strikes per turbine per year.

Song D, Wang XH, Zhu X, Bao X. 2013. Modeling studies of the far-field effects of tidal flat reclamation on tidal dynamics in the East China Seas. *Estuarine, Coastal and Shelf Science* **133**, 147-160.

(Abstract)

In recent decades, the reclamation of tidal flat carried out by the authorities around the Bohai Sea, Yellow Sea, and East China Sea (BYECS) has reached new heights as a consequence of significant economic expansion in the coastal areas. We are concerned that the tidal flat reclamation may have not only local but also far-field effects on tidal dynamics in the entire BYECS. Numerical study shows different tidal patterns due to tidal energy redistribution when tidal flats around the BYECS are removed, in which the tidal range and phase are changed, and the amphidromic points are displaced. Tidal flats provide storage and dissipation for tidal energy; the former is much more significant than the latter. Loss of these functions caused by tidal flat reclamation will induce a redistribution of the extra tidal energy. Furthermore, we show that far-field effects on tidal dynamics would be observed on the west coast of Korea following

significant reclamation on the Chinese Jiangsu coast. In turn, reclamation on the west coast of Korea may generate the far-field effects on the Chinese coast. Reclamation in the BYECS can result in rise of tidal amplitude and onshore sediment transport. The former may enhance the coastal hazards such as storm surge, and the latter may result in severe siltation. Therefore, careful consideration must always be given to any proposed artificial changes to tidal flat, given the effects of these on both the local environment and further afield.

McLeod EM, Guay P-J, Taysom AJ, Robinson RW, Weston MA. 2013. Buses, Cars, Bicycles and Walkers The Influence of the Type of Human Transport on the Flight Responses of Waterbirds. *PLoS ONE* **8**, e82008.

(Abstract)

One way to manage disturbance to waterbirds in natural areas where humans require access is to promote the occurrence of stimuli for which birds tolerate closer approaches, and so cause fewer responses. We conducted 730 experimental approaches to 39 species of waterbird, using five stimulus types (single walker, three walkers, bicycle, car and bus) selected to mimic different human management options available for a controlled access, Ramsar-listed wetland. Across species, where differences existed (56% of 25 cases), motor vehicles always evoked shorter flight-initiation distances (FID) than humans on foot. The influence of stimulus type on FID varied across four species for which enough data were available for complete cross-stimulus analysis. All four varied FID in relation to stimuli, differing in 4 to 7 of 10 possible comparisons. Where differences occurred, the effect size was generally modest, suggesting that managing stimulus type (e.g. by requiring people to use vehicles) may have species-specific, modest benefits, at least for the waterbirds we studied. However, different stimulus types have different capacities to reduce the frequency of disturbance (i.e. by carrying more people) and vary in their capacity to travel around important habitat.

Schlacher TA, Nielsen T, Weston MA. 2013. Human recreation alters behaviour profiles of non-breeding birds on open-coast sandy shores. *Estuarine, Coastal and Shelf Science* **118**, 31-42.

(Abstract)

Sandy beaches are primarily valued for their amenity and property values rather than for their ecological functions and properties. Some human usage of beaches potentially conflicts with the conservation and management of wildlife, such as beach-dwelling birds, on sandy shorelines. Because responses by birds to environmental change, including disturbance by humans, often involve behaviours that carry fitness costs, we quantify behaviour profiles of birds in relation to human occurrence along 200 km of sandy shoreline in Eastern Australia,

including the large conservation area of Fraser Island. Disturbance to birds on these shores was considerable: 1) birds encountered motorized vehicles (cars, trucks, buses etc.) during 80% of focal bird observation bouts, 2) birds were flushed in over half (up to 86% in individual species) of all bouts, and 3) individuals spent, on average, one-third of their time on disturbance-related behaviours; this was particularly prevalent for Crested Terns (*Thalasseus bergii*) which were alert 42% of the time and spent 12% of their time escaping from human stimuli. Overall, this study demonstrated that motorized traffic is the prime agent of disturbance to birds on these beaches, resulting in frequent and time-consuming escape behaviours. These findings also emphasize that management of vehicle-based recreation on beaches needs to be re-aligned to meet conservation requirements in addition to providing leisure opportunities in National Parks and beyond; we identify some salient issue for this development: a) encouragement of social norms that promote environmentally benign beach use not involving motor vehicles, b) creation of spatial refuges for beach wildlife from traffic and other noncompatible uses, and c) investment in developing complementary management actions such as effective set-back distances.

Thiebes B, Wang J, Bai S, Li J. 2013. Terrestrial laser scanning of tidal flats—a case study in Jiangsu Province, China. *Journal of Coastal Conservation* **17**, 813–823.

(Abstract)

Terrestrial laser scanning (TLS), also called ground-based LiDAR (Light Detection And Ranging) is a relatively new method which revolutionised geomorphological research in many domains. However, detailed studies of tidal flats by TLS have not been described in the literature yet. This study aims to fill this methodological gap by the application of TLS at two different locations on the coast of Jiangsu Province, Eastern China, and an assessment of the usability of this method for geomorphological research in such environments. The acquired point clouds are first processed to remove erroneous and noisy points. Subsequently, point clouds are computed to produce polygonal meshes and grid-based digital terrain model (DTM) more commonly used by the scientific community. The accuracy of the measurements is assessed by an analysis of elevation deviations for flat and horizontal concrete blocks. High quality point clouds with point densities of up to 4,000 points/m2 were acquired for a distance of up to 200 m. The data allowed for the detection of small landforms such as tidal channels, creeks and ripples in centimetre and decimetre scale. The point clouds had an average error of approximately 3 mm, however for some few points errors of up to 1.8 cm were detected. Based on the results it can be concluded that TLS can be a useful additional method for geomorphological research on tidal flats due to its ability to describe the landforms from high density point clouds. Repeated scanning could therefore provide data to quantitatively and qualitatively describe geomorphological changes over wider areas and thereby improve the understanding of sedimentation and erosion on tidal flats.

Loss SR, Will T, Marra PP. 2013. Estimates of bird collision mortality at wind facilities in the contiguous United States. *Biological Conservation* **168**, 201–209.

(Abstract)

Wind energy has emerged as a promising alternative to fossil fuels, yet the impacts of wind facilities on wildlife remain unclear. Prior studies estimate between 10,000 and 573,000 fatal bird collisions with U.S. wind turbines annually; however, these studies do not differentiate between turbines with a monopole tower and those with a lattice tower, the former of which now comprise the vast majority of all U.S. wind turbines and the latter of which are largely being de-commissioned. We systematically derived an estimate of bird mortality for U.S. monopole turbines by applying inclusion criteria to compiled studies, identifying correlates of mortality, and utilizing a predictive model to estimate mortality along with uncertainty. Despite measures taken to increase analytical rigor, the studies we used may provide a non-random representation of all data; requiring industry reports to be made publicly available would improve understanding of wind energy impacts. Nonetheless, we estimate that between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with monopole turbines in the contiguous U.S. We found support for an increase in mortality with increasing turbine hub height and support for differing mortality rates among regions, with per turbine mortality lowest in the Great Plains. Evaluation of risks to birds is warranted prior to continuing a widespread shift to taller wind turbines. Regional patterns of collision risk, while not obviating the need for species-specific and local-scale assessments, may inform broad-scale decisions about wind facility siting.

MacKinnon CM, Kennedy AC, Horsman Ml. 2013. Flight of a flock of Common Eiders, *Somateria mollisima*, in Northumberland Strait interrupted by the Confederation Bridge, New Brunswick–Prince Edward Island. *Canadian Field-Naturalist* **127**, 175–177.

(Abstract)

An observation of the flight of a flock of Common eiders, *Somateria mollisima*, on 24 October 2012 suggests that, 15 years after construction of the Confederation Bridge connecting New Brunswick and Prince Edward island (12.9 km in length over the Northumberland Strait), the bridge may still be a partial barrier to bird flight and possibly migration. Although we believe the Common eiders we observed intended to fly over or under the bridge, none of the 44 Common eiders crossed the structure during the observation period.

Le Corre N, Peuziat I, Brigand L, Gelinaud G, Meur-Ferec C. 2013. Wintering Waterbirds and Recreationists in Natural Areas: A Sociological Approach to the Awareness of Bird Disturbance. *Environmental Management* **52**, 780–791.

(Abstract)

Disturbance to wintering birds by human recreational activities has become a major concern for managers of many natural areas. Few studies have examined how recreationists perceive their effects on birds, although this impacts their behavior on natural areas. We surveyed 312 users on two coastal ornithological sites in Brittany, France, to investigate their perception of the effects of human activities on wintering birds. The results show that the awareness of environmental issues and knowledge of bird disturbance depends on the socioeconomic characteristics of each user group, both between the two sites and within each site. Results also indicate that, whatever the site and the user group, the vast majority of the respondents (77.6 %) believed that their own presence had no adverse effects on the local bird population. Various arguments were put forward to justify the users' own harmlessness. Objective information on recreationists' awareness of environmental issues, and particularly on their own impact on birds, is important to guide managers in their choice of the most appropriate visitor educational programs. We recommend developing global but also specific educational information for each type of user to raise awareness of their own impact on birds.

Downard R, Endter-Wada J. 2013. Keeping wetlands wet in the western United States: Adaptations to drought in agriculture-dominated human-natural systems. *Journal of Environmental Management* **131**, 394-406.

(Abstract)

Water is critical to protecting wetlands in arid regions, especially in agriculture-dominated watersheds. This comparative case study analyzes three federal wildlife refuges in the Bear River Basin of the U.S. West where refuge managers secured water supplies by adapting to their local environmental context and their refuge's relationship to agriculture in being either irrigation-dependent, reservoir-adjacent or diked-delta wetlands. We found that each refuge's position confers different opportunities for securing a water supply and entails unique management challenges linked to agricultural water uses. Acquiring contextually-appropriate water rights portfolios was important for protecting these arid region wetlands and was accomplished through various strategies. Once acquired, water is managed to buffer wetlands against fluctuations caused by a dynamic climate and agricultural demands, especially during droughts. Management plans are responsive to needs of neighboring water users and values of the public at large. Such context-specific adaptations will be critical as the West faces climate change and population growth that threaten wetlands and agricultural systems to which they are linked.

Orłowski G. 2013. Factors affecting the use of waste-stabilization ponds by birds: A case study of conservation implications of a sewage farm in Europe. *Ecological Engineering* **61**, 436– 445.

(Abstract)

The progressive loss of natural wetlands globally means that anthropogenic water reservoirs are increasingly important as habitat for wetland bird species. During yearly bird counts (in one-week intervals) on seven waste-stabilization ponds (size range = 0.379–4.450 ha; total = 8.392 ha) located on a large sewage farm in a Wrocław city suburb (south-west Poland), I recorded a total of 7776 individuals from 84 bird species. The most numerous bird guild was waterbirds (45.8% of the community), followed by shorebirds (35.7%), passerines (14.9%) and aerial feeders (3.5%). In general, the density (including all bird guilds) and species diversity of birds was positively related to the bed exposure and 'naturalness' (artificial ≈ small ponds with preliminary treatment versus natural ≈ large ponds after preliminary treatment) of the waste-stabilization ponds. The compulsory European Union (EU) law regulating urban wastewater treatment (The Council Directive 91/271/EEC, Urban Waste Water Treatment Directive) does not permit use of open sewage farms as a method of treatment for domestic and other wastewater. In many new EU member states, the sewage fields are still used, although this method of sewage treatment will function only until 2015, and after that all wastewater must be purified in modern sewage treatment works. It is recommended that areas historically used as sewage farms located on the outskirts of large cities should be converted into protected areas. However, due to the contamination of invertebrates that inhabit and emerge from sewage treatment works, and the potential high risk of detrimental effects on bird species that feed on such prey, empty waste-stabilization ponds should be re-filled with clean natural water sources such as rain and spring water or alternatively with well-treated waste water. The strategy for managing such areas requires a proper water regime and maintenance of the periodically dry bottom, a crucial feeding area for birds.

White CR, Green JA, Martin GR, Butler PJ, Grémillet D. 2013. Energetic constraints may limit the capacity of visually guided predators to respond to Arctic warming. *Journal of Zoology* **289,** 119-126.

(Abstract)

For many polar species, climate change is likely to result in range contractions and negative population trends. For those species whose distribution is limited by sea ice and cold water, however, polar warming could result in population increases and range expansion. Population increases of great cormorants *Phalacrocorax carbo* in Greenland are associated with warmer sea surface temperatures, but the actual impact of environmental change on cormorant spatial ecology remains unclear. In the present study, we investigate how Arctic warming is likely to influence the distribution of cormorants in Greenland. Using geolocation data, we show that many individuals that breed above the Arctic Circle migrate south and winter at lower latitude. We then couple estimates of migratory flight costs with a model that predicts daily energy

expenditure during winter on the basis of water temperature, ambient illumination during diving, dive depth and day length. This model shows that the most energy efficient strategy predicted for any breeding location is to migrate as far south as possible, and that, for a given wintering location, it is more energetically expensive to breed at high latitude. We argue that cormorants currently undertake a winter migration to escape the polar night and reduce winter energy costs and that their wintering grounds in Greenland will remain largely unchanged under Arctic warming. This is because low levels of ambient illumination during the polar night will continue to restrict foraging opportunities at high latitude during winter. Northward expansion of the breeding range will result in increased energy expenditure associated with long migratory flights, and the cost of such flights may ultimately limit the breeding range of cormorants. Such limitations are likely to represent a general constraint on the capacity of visually guided predators to respond to climate warming, and may limit the predicted poleward range shifts of these species.

Peron G, Hines JE, Nichols JD, Kendall WL, Peters KA, Mizrahi DS. 2013. Estimation of bird and bat mortality at wind-power farms with superpopulation models. *Journal of Applied Ecology* **50,** 902–911.

(Abstract)

1. Collision of birds and bats with turbines in utility-scale wind farms is an increasing cause of concern.

2. Carcass counts conducted to quantify the ‘take’ of protected species need to be corrected for carcass persistence probability (removal by scavengers and decay) and detection probability (searcher efficiency). These probabilities may vary with time since death, because of intrinsic changes in carcass properties with age and of heterogeneity (preferential removal of easy-to-detect carcasses).

3. In this article, we describe the use of superpopulation capture–recapture models to perform the required corrections to the raw count data. We review how to make such models age specific and how to combine trial experiments with carcass searches in order to accommodate the fact that carcasses are stationary (which affects the detection process).

4. We derive information about optimal sampling design (proportion of the turbines to sample, number of sampling occasions, interval between sampling occasions) and use simulations to illustrate the expected precision of mortality estimates. We analyse data from a small wind farm in New Jersey, in which we find the estimated number of fatalities to be twice the number of carcasses found.

5. Synthesis and applications. Our approach to estimation of wind farm mortality based on data from carcass surveys is flexible and can accommodate a range of different sampling designs and biological hypotheses. Resulting mortality estimates can be used (1) to quantify the required amount of compensation actions, (2) to inform mortality projections for proposed wind development sites and (3) to inform decisions about management of existing wind farms.

Williamson L, Hudson M, O'Connell M, Davidson NC, Young R, Amano T, Székely T. 2013. Areas of high diversity for the world's inland-breeding waterbirds. *Biodiversity and Conservation* **22,**1501-1512.

(Abstract)

Waterbirds are a globally-distributed, species-rich group of birds that are critically dependent upon wetland habitats. They can be used as ecosystem sentinels for wetlands, which as well as providing ecosystem services and functions essential to humans, are important habitats for a wide range of plant and animal taxa. Here we carry out the first global analysis of inland-breeding waterbird distributions using data from 471 waterbird species in 28 families to identify global areas of high waterbird diversity. First, we identify the primary area of high diversity for all inland-breeding waterbird species to be in Eastern Africa. For globally threatened inland-breeding waterbirds, the area of highest diversity is in Eastern China. Second, we show that the current network of protected areas provides poor coverage for threatened waterbirds in Eastern and Central Asia, and Northern India. In contrast, there is a higher protected area coverage in most of Europe and Brazil. Targeting the specific areas that have the highest numbers of species and the poorest coverage of protected areas is vital for both waterbird and wetland conservation.

Bartolini F, Barausse A, Portner H-O, Giomi F. 2013. Climate change reduces offspring fitness in littoral spawners: a study integrating organismic response and long-term time-series. *Global Change Biology* **19,** 373–386.

(Abstract)

Integrating long-term ecological observations with experimental findings on species response and tolerance to environmental stress supports an understanding of climate effects on population dynamics. Here, we combine the two approaches, laboratory experiments and analysis of multi-decadal time-series, to understand the consequences of climate anomalies and ongoing change for the population dynamics of a eurythermal littoral species, *Carcinus aestuarii*. For the generation of cause and effect hypotheses we investigated the thermal response of crab embryos at four developmental stages. We first measured metabolic rate variations in embryos following acute warming (16–24 °C) and after incubation at 20 and 24 °C for limited periods. All experiments consistently revealed differential thermal responses depending on the developmental stage. Temperature-induced changes in metabolic activity of early embryonic stages of blastula and gastrula suggested the onset of abnormal development. In contrast, later developmental stages, characterized by tissue and organ differentiation, were marginally affected by temperature anomalies, indicating enhanced

resilience to thermal stress. Then, we extended these findings to a larger, population scale, by analyzing a time-series of C. *aestuarii* landings in the Venice lagoon from 1945 to 2010 (ripe crabs were recorded separately) in relation to temperature. Landings and extreme climatic events showed marked long-term and short-term variations. We found negative relationships between landings and thermal stress indices on both timescales, with time lags consistent with an impact on crab early life stages. When quantitatively evaluating the influence of thermal stress on population dynamics, we found that it has a comparable effect to that of the biomass of spawners. This work provides strong evidence that physiological responses to climatic anomalies translate into population-level changes and that apparently tolerant species may be impacted before the ontogeny of eurythermy. These ontogenetic bottlenecks markedly shape population dynamics and require study to assess the effects of global change.

McKinnon L, Nol E, Juillet C. 2013. Arctic-nesting birds find physiological relief in the face of trophic constraints. *Scientific Reports* **3,** 1-6.

(Abstract)

A climate-induced phenological mismatch between the timing of reproduction and the timing of food resource peaks is one of the key hypothesized effects of climate change on wildlife. Though supported as a mechanism of population decline in birds, few studies have investigated whether the same temperature increases that drive this mismatch have the potential to decrease energetic costs of growth and compensate for the potential negative effects of reduced food availability. We generated independent indices of climate and resource availability and quantified their effects on growth of Dunlin (*Calidris alpina*) chicks, in the sub-arctic tundra of Churchill, Manitoba during the summers of 2010–2011 and found that when resource availability was below average, above average growth could be maintained in the presence of increasing temperatures. These results provide evidence that chicks may find physiological relief from the trophic constraints hypothesized by climate change studies.

Wang Y, Hou X, Shi P, Yu L. 2013. Detecting Shoreline Changes in Typical Coastal Wetlands of Bohai Rim in North China. *Wetlands* **33,** 617-629.

(Abstract)

Coastal wetland shoreline change represents one of the most important land-ocean interaction processes in complex and dynamic coastal environment. This paper presents the detecting of shoreline changes in four typical coastal wetlands of ecological importance along Bohai rim based on multi-temporal shorelines extracted from obtained Normalized Difference Water Index (NDWI) images using automatic binarization algorithm. Results showed that although

there were statistical uncertainties dominant trends of the shoreline changes could be detected and sections that had significant area changes could be identified from satellite images. The reasons for corresponding changes occurred in these wetlands were stated in terms of natural processes and anthropogenic activities. It is our anticipation that this work would help future studies to reveal the regional/national pattern of wetland changes and support wetland protection and management in China's coast zone.

Lehikoinen A, Jaatinen K, Vähätalo AV, Clausen P, Crowe O, Deceuninck B, Hearn RD, Holt CA, Hornman M, Keller V, Nilsson L, Langendoen T, Tománková I, Wahl J, Fox AD. 2013. Rapid climate driven shifts in wintering distributions of three common waterbird species. *Global Change Biology*ng> 19, 2071-2081.

(Abstract)

Climate change is predicted to cause changes in species distributions and several studies report margin range shifts in some species. However, the reported changes rarely concern a species' entire distribution and are not always linked to climate change. Here, we demonstrate strong north-eastwards shifts in the centres of gravity of the entire wintering range of three common waterbird species along the North-West Europe flyway during the past three decades. These shifts correlate with an increase of 3.8 °C in early winter temperature in the north-eastern part of the wintering areas, where bird abundance increased exponentially, corresponding with decreases in abundance at the south-western margin of the wintering ranges. This confirms the need to re-evaluate conservation site safeguard networks and associated biodiversity monitoring along the flyway, as new important wintering areas are established further north and east, and highlights the general urgency of conservation planning in a changing world. Range shifts in wintering waterbirds may also affect hunting pressure, which may alter bag sizes and lead to population-level consequences.

Grabowski MM, Doyle FI, Reid DG, Mossop D, Talarico D. 2013. Do Arctic-nesting birds respond to earlier snowmelt? A multi-species study in north Yukon, Canada. *Polar Biology***36**, 1097–1105.

(Abstract)

Climate change has altered the timing of many ecological processes, especially in the Arctic. The initiation of nesting is a key signal of phenological changes in Arctic-nesting birds, and is possibly connected to the circumpolar trend of earlier snowmelt. We collected data on lay dates of 7 bird species, representing shorebirds, passerines, a bird of prey, and seabirds, nesting on Herschel Island, Yukon, Canada, in the years 1984–1986 and 2007–2009. Snowmelt was significantly earlier in the 2007–2009 period. Shorebirds and passerines

showed trends to earlier lay dates in conjunction with earlier snowmelt; the other species did not. The strength of response in lay date was correlated with the general categories of foods known to be used by study species. However, six species showed a longer time interval between snowmelt and egg-laying in early compared to late springs, suggesting the need for further monitoring of how robust their responses to snowmelt are in the future.

Iwamura T, Possingham HP, Chadès I, Minton CDT, Murray NJ, Rogers DI, Treml EA, Fuller RA. 2013. Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations.*Proceedings of the Royal Society of London,* **B 280,** 2013/03/25.

(Abstract)

Sea-level rise (SLR) will greatly alter littoral ecosystems, causing habitat change and loss for coastal species. Habitat loss is widely used as a measurement of the risk of extinction, but because many coastal species are migratory, the impact of habitat loss will depend not only on its extent, but also on where it occurs. Here, we develop a novel graph-theoretic approach to measure the vulnerability of a migratory network to the impact of habitat loss from SLR based on population flow through the network. We show that reductions in population flow far exceed the proportion of habitat lost for 10 long-distance migrant shorebirds using the East Asian–Australasian Flyway. We estimate that SLR will inundate 23–40% of intertidal habitat area along their migration routes, but cause a reduction in population flow of up to 72 per cent across the taxa. This magnifying effect was particularly strong for taxa whose migration routes contain bottlenecks—sites through which a large fraction of the population travels. We develop the bottleneck index, a new network metric that positively correlates with the predicted impacts of habitat loss on overall population flow. Our results indicate that migratory species are at greater risk than previously realized.

Liang W, Cai Y, Yang C-C. 2013. Extreme levels of hunting of birds in a remote village of Hainan Island, China. *Bird Conservation International* **23,** 45–52.

(Abstract)

In China, many bird species are generally thought to be threatened mainly, or at least partly, by hunting. However, there have been few studies of bird hunting at a local scale. Bird hunting and trade in Nanmao, a remote mountainous village of Hainan Island, China, was investigated during March–July 2003 and September–October 2005. In total, 86 households were visited, of which 43% reported that they engaged in hunting of birds while 91% of households were seen to have hunted birds or hunting tools. This indicated that hunting by village people was widespread. Most hunters were male, and were between 12 and 68 years old. A total of 78 bird species were hunted, including 2 First Class and 19 Second Class national protected

species. This extreme level of hunting has changed from a more moderate subsistence hunting tradition since about 1980, when local urban markets for wild meat started to develop. We outline a strategic plan designed to conserve birds, other wildlife and their forest habitats, whilst improving the livelihoods and preserving the minority tribal traditions of the people of Nanmao forest.

Threats 2012

MaMing, R., T. Zhang, D. Blank, P. Ding, and X. Zhao. 2012. Geese and ducks killed by poison and analysis of poaching cases in China. *Goose Bulletin* **15**:2-11.

(Abstract)

Geese and ducks are widely distributed birds in China. They have long migration routes and large overwintering areas along the Yellow and Yangtze rivers. Geese and ducks are a very important food resource for the public, but at the same time, these birds suffer from wide-scale hunting by poachers. More than ten hunting methods are used by poachers. Poisoning is the most dangerous form of poaching, causing the complete destruction of natural resources. We estimate that between 80,000 and 120,000 waterbirds of about 40 species are hunted every year. Geese, ducks and swans account for the greatest numbers. All provinces except Tibet have suffered bird-hunting between 2002 and 2012. Poaching activities are still very common during spring and autumn in China.

Duriez O, Ens BJ, Choquet R, Pradel R, Klaassen M. 2012. Comparing the seasonal survival of resident and migratory oystercatchers: carry-over effects of habitat quality and weather conditions. *Oikos* **121,** 862–873.

(Abstract)

Events happening in one season can affect life-history traits at (the) subsequent season(s) by carry-over effects. Wintering conditions are known to affect breeding success, but few studies have investigated carry-over effects on survival. The Eurasian oystercatcher *Haematopus ostralegus* is a coastal wader with sedentary populations at temperate sites and migratory populations in northern breeding grounds of Europe. We pooled continental European ringing-recovery datasets from 1975 to 2000 to estimate winter and summer survival rates of migrant and resident populations and to investigate long-term effects of winter habitat changes. During mild climatic periods, adults of both migratory and resident populations exhibited survival rates 2% lower in summer than in winter. Severe winters reduced survival rates (down to 25%

reduction) and were often followed by a decline in survival during the following summer, via short-term carry-over effects. Habitat changes in the Dutch wintering grounds caused a reduction in food stocks, leading to reduced survival rates, particularly in young birds. Therefore, wintering habitat changes resulted in long-term (>10 years) 8.7 and 9.4% decrease in adult annual survival of migrant and resident populations respectively. Studying the impact of carry-over effects is crucial for understanding the life history of migratory birds and the development of conservation measures.

Alrashidi M, Shobrak M, Al-Eissa MS, Székely T. 2012. Integrating spatial data and shorebird nesting locations to predict the potential future impact of global warming on coastal habitats: A case study on Farasan Islands, Saudi Arabia. *Saudi Journal of Biological Sciences* **19,** 311–315.

(Abstract)

One of the expected effects of the global warming is changing coastal habitats by accelerating the rate of sea level rise. Coastal habitats support large number of marine and wetland species including shorebirds (plovers, sandpipers and allies). In this study, we investigate how coastal habitats may be impacted by sea level rise in the Farasan Islands, Kingdom of Saudi Arabia. We use Kentish plover *Charadrius alexandrinus* – a common coastal breeding shorebird – as an ecological model species to predict the influence of sea level rise. We found that any rise of sea level is likely to inundate 11% of Kentish plover nests. In addition, 5% of the coastal areas of Farasan Islands, which support 26% of Kentish plover nests, will be flooded, if sea level rises by one metre. Our results are constrained by the availability of data on both elevation and bird populations. Therefore, we recommend follow-up studies to model the impacts of sea level rise using different elevation scenarios, and the establishment of a monitoring programme for breeding shorebirds and seabirds in Farasan Islands to assess the impact of climate change on their populations.

Estelle V, Grosholz ED. 2012. Experimental Test of the Effects of a Non-Native Invasive Species on a Wintering Shorebird. *Conservation Biology* **26,** 472-481.

(Abstract)

The abundance of nearly one-quarter of the world's shorebird species is declining. At the same time, the number of non-native species in coastal ecosystems is increasing rapidly. In some cases, non-native species may affect negatively the abundance and diversity of shorebird prey species. We conducted an experimental study of the effects of the introduced European green crab (*Carcinus maenas*) on prey consumption by wintering Dunlin (*Calidris alpina*) in a central California estuary. We placed green crabs and Dunlin sequentially in field enclosures and

measured changes in density of benthic invertebrate prey (e.g. *polychaetes*and small clams), Dunlin biomass, and gut contents of both Dunlin and crabs and observed foraging behavior of Dunlin. Green crabs significantly affected Dunlin foraging success through both direct and indirect multitrophic linkages. In enclosures with high densities of green crabs, crab foraging reduced the availability of polychaetes, and Dunlin consumed significantly fewer polychaetes compared with Dunlin in enclosures without crabs. High densities of green crabs were also associated with increased availability of small clams. Dunlin consumed significantly more small clams compared with Dunlin in enclosures without crabs. In our literature survey of studies of effects of non-native invasive species on shorebirds, we found three prior experiments that addressed the effect of non-native invasive species on shorebirds. Results of two of these studies showed positive direct effects of non-native invertebrates on shorebirds, 1 showed negative direct effects of a non-native plant on shorebirds through habitat conversion, and none showed indirect effects of non-native invertebrates. We suggest future management of shorebirds explicitly examine how non-native marine species, particularly invertebrates, directly and indirectly affect shorebirds.

Verkuil YI, Karlionova N, Rakhimberdiev EN, Jukema J, Wijmenga JJ, Hooijmeijer JCEW, Pinchuk P, Wymenga E, Baker AJ, Piersma T. 2012. Losing a staging area: Eastward redistribution of Afro-Eurasian ruffs is associated with deteriorating fuelling conditions along the western flyway.*Biological Conservation* **149,** 51–59.

(Abstract)

The fuelling performance of long-distance migrants at staging areas indicates local conditions and determines the viability of migration routes. Here we present a first case study where long-term fuelling performance was documented along two migration routes with differential population trends. Ruffs (*Philomachus pugnax*) are shorebirds of inland freshwater wetlands that migrate from the sub-Saharan wintering grounds, via Europe, to the northern Eurasian breeding grounds. Assessments from 2001 to 2008 of fuelling during northward migration at the major western and eastern staging site revealed that daily mass gain rates steeply declined across years in the grasslands for dairy production in Friesland, The Netherlands, and remained constant in the Pripyat floodplains in Belarus, 1500 km further east. Migrants in Friesland decreased from 2001 to 2010 by 66%, amounting to a loss of 21,000 individuals when counts were adjusted for length of stay as determined by resightings. In the same period numbers in Pripyat increased by 12,000. Ruffs individually ringed in Friesland were resighted in subsequent springs at increasingly eastern sites including Pripyat. Our results corroborate published evidence for an eastward redistribution of Arctic breeding ruffs and suggest that the decreasing fuelling rates in the westernmost staging area contribute to this redistribution. The shift implies that responses occur within a single generation. The hypothesis that the choice of route during northward migration may be driven by food availability can now be tested by creating greater areas of wet grasslands in Friesland. When local staging conditions improve we predict that ruffs will make the reverse shift.

Convertino M, Welle P, Muñoz-Carpena R, Kiker GA, Chu-Agor ML, Fischer RA, Linkov I. 2012. Epistemic uncertainty in predicting shorebird biogeography affected by sea-level rise. *Ecological Modelling* **240,** 1–15.

(Abstract)

Accurate spatio-temporal predictions of land-cover are fundamentally important for assessing geomorphological and ecological patterns and processes. This study quantifies the epistemic uncertainty in the species distribution modeling, which is generated by spatio-temporal gaps between the biogeographical data, model selection and model complexity. Epistemic uncertainty is generally given by the sum of subjective and objective uncertainty. The subjective uncertainty generated by the modeler-choice in the manipulation of the environmental variables was analyzed. The Snowy Plover in Florida (*Charadrius alexandrinus nivosus*, SP), a residential shorebird whose geographic range is extended along the Panhandle-Big Bend-Peninsula Gulf coast was considered as case-study. The first fundamental step for studying the species distribution and how it will be affected by climate change is to obtain an accurate description of the shorebird coastal habitat. The land-cover was translated into ecosystem classes using a land-cover model that predicts the evolution of coastal ecosystems affected by sea-level rise scenarios. The best land-cover map decreased the objective uncertainty (intrinsically present in data or models) in representing the spatial structure of the coastal ecosystem, reduced the temporal gaps with the occurrence data, and diminished the subjective uncertainty due to the conversion from land-cover to model-classes. Multimodeling was performed to reduce the uncertainty in the prediction of the species distribution related to model uncertainty. The best representation of the species distribution was performed by MaxEnt. The area under the receiver operating characteristic curve (AUC), the omission/commission test, the similarity index of the response curves, and the jackknife test were used simultaneously as indicators of the predictability of each species distribution model. The availability of updated high-resolution biogeoclimatological data was proven to be necessary in order to properly predict the species ranges for conservation purposes.

Gao X, Li P. 2012. Concentration and fractionation of trace metals in surface sediments of intertidal Bohai Bay, China. *Marine Pollution Bulletin* **64,** 1529-1536.

(Abstract)

Surface sediments from intertidal Bohai Bay were sampled for the geochemical and environmental assessment of six trace metals (Cd, Cr, Cu, Ni, Pb and Zn). Results indicate that sediment grain size plays an important role in controlling the distribution and fractionation of them. Metal concentrations in clayey silt sediments are all clearly higher than in sand and silty sand ones. Cd and Pb in clayey silt sediments are more mobile than in sand and silty sand ones. Two sediment quality guidelines and two geochemical normalization methods

(index of geoaccumulation and enrichment factor) were used to judge the potential risk and accumulation of metals. According to the mean probable effects level quotient, the combination of studied metals may have a 21% probability of being toxic. The sediments with high fraction of clay and silt have been contaminated by trace metals to various degrees, among which Cr contributes the most to contamination.

Silva C, Mattioli M, Fabbri E, Yáñez E, DelValls TA, Martín-Díaz ML. 2012. Benthic community structure and biomarker responses of the clam Scrobicularia plana in a shallow tidal creek affected by fish farm effluents (Rio San Pedro, SW Spain). *Environment International* **47,** 86–98.

(Abstract)

The effects of solid organic wastes from a marine fish farm on sediments were tested using benthic community as ecological indicators and biomarkers in native clam (*Scrobicularia plana*) as biochemical indicators. The benthic fauna and clam samples were collected in the intertidal sediment in October 2010 from five sites of the Rio San Pedro (RSP) creek, following a gradient of contamination from the aquaculture effluent to the control site. Numbers of species, abundance, richness and Shannon diversity were the biodiversity indicators measured in benthic fauna. Morphological and reproduction status of clams were assessed using the condition factor and gonado-somatic index, respectively. Phase I and Phase II detoxification enzymatic activities (ethoxyresorufin O-deethylase (EROD), glutathione S-transferase (GST)), antioxidant enzymatic activities (glutathione peroxidase (GPX), glutathione reductase (GR)) and oxidative stress parameters (Lipid Peroxidation (LPO) and DNA strand breaks) were measured in clams' digestive gland tissues. In parallel, temperature and salinity in the adjacent water, redox potential, pH and organic matter in sediment, and dissolved oxygen in the interstitial water were measured. The results suggested that RSP showed a spatial gradient characterised by hypoxia/anoxia, reduced potential, acidic conditions and high organic enrichment in sediments at the most contaminated sites. Significant ($p < 0.05$) decrease of biodiversity indicators were observed in the areas impacted by the aquaculture discharges. Biomarkers did not show a clear pattern and of all biochemical responses tested, GPX, DNA damage and LPO were the most sensitive ones and showed significant ($p < 0.05$) increase in the polluted sites. Benthic biodiversity indicators were significantly ($p < 0.05$) positively correlated with pH, redox potential and dissolved oxygen and negatively correlated with organic matter. On the contrary, antioxidant enzymatic responses (GPX) and oxidative stress parameters were significantly ($p < 0.05$) negatively correlated with those physico-chemical parameters. It has been demonstrated that effluents from fish aquaculture activities in Río San Pedro creek may produce an alteration of physico-chemical characteristics of seabed and induce oxidative stress and DNA damage in soft-sediment species which may lead to changes of the benthic population structure and health status of the exposed organisms.

Anteau MJ, Shaffer TL, Sherfy MH, Sovada MA, Stucker JH, Wiltermuth MT. 2012. Nest survival of piping plovers at a dynamic reservoir indicates an ecological trap for a threatened population.*Oecologia* **170,** 1167-1179.

(Abstract)

In the past 60 years, reservoirs have reshaped riverine ecosystems and transformed breeding habitats used by the threatened piping plover (*Charadrius melodus*; hereafter plover). Currently, 29 % of the Northern Great Plains plover population nests at reservoirs that might function as ecological traps because reservoirs have more diverse habitat features and greater dynamics in water levels than habitats historically used by breeding plovers. We examined factors influencing daily survival rates (DSR) of 346 plover nests at Lake Sakakawea (SAK; reservoir) during 2006–2009 by evaluating multiple a priori models, and we used our best model to hindcast nest success of plovers during 1985–2009. Our observed and hindcast estimates of nest success were low compared to published estimates. Previous findings indicate that plovers prefer nest sites that are low relative to water level. We found that elevation of nests above the water level had a strong positive correlation with DSR because water levels of SAK typically increased throughout the nesting period. Habitat characteristics on the reservoir differ from those that shaped nest-site selection for plovers. Accordingly, extraordinary nest loss occurs there in many years, largely due to inundation of nests, and based on low fledging rates those losses were not compensated by potential changes in chick survival. Therefore, our example supports the concept of ecological traps in birds because it addresses quantitative assessments of habitat preference and productivity over 25 years (since species listing) and affects a large portion of the population.

Meager JJ, Schlacher TA, Nielsen T. 2012. Humans alter habitat selection of birds on ocean-exposed sandy beaches. *Diversity and Distributions* **18,** 294–306.

(Abstract)

Aim: Resource-selection functions (RSFs) can quantify and predict the density of animal populations across heterogeneous landscapes and are important conservation tools in areas subject to human disturbance. Sandy beach ecosystems have comparatively low habitat heterogeneity and structural relief in the intertidal zone, but intense human use. We aimed to develop predictive RSFs for birds on ocean-exposed sandy beaches at two spatial scales, 25 ha (local scale) and 250 ha (landscape scale), and to test whether habitat selection of birds that commonly use the surf–beach–dune interface is influenced by the rates of human activities.

Location: Moreton and North Stradbroke Island, eastern Australia.

Methods: Avifauna and human activities were mapped on three sandy beaches covering 79 km of coastline for 15 months. Habitat characteristics of the surf– beach–dune interface were

derived from remote sensing and ground surveys. RSFs were developed for 12 species of birds at two spatial scales: 25 ha (local scale) and 250 ha (landscape scale).

Results: At local (25 ha) and landscape scales (250 ha), dune dimensions and the extent and type of vegetation structure were important predictors of bird density. Adding the frequency of human activities improved the predictive power of RSFs, suggesting that habitat selection of birds on beaches is modified by human use of these environments. Human activities occurred mostly in the mid- to lower intertidal zone of the beach, overlapping closely with the preferred habitats of Silver Gulls (*Larus novaehollandiae*), Pied Oystercatchers (*Haematopus longirostris*), Red-capped Plovers (*Charadrius ruficapillus*) and endangered Little Terns (*Sternula albifrons*).

Main conclusions: In addition to demonstrating the appropriateness of RSFs to the surf–beach–dune interface, our results stress the need for systematic conservation planning for these ecosystems, where ecological values have traditionally been subsidiary to the maintenance of sand budgets and erosion control.

Sutherland WJ, Alves JA, Amano T, Chang CH, Davidson NC, Finlayson CM, Gill JA, Gill Jr RE, Gonzalez PM, Gunnarsson TG, Kleijn D, Spray CJ, Székely T, Thompson DBA. 2012. A horizon scanning assessment of current and potential future threats to migratory shorebirds.*Ibis* **154,** 663-679.

(Abstract)

We review the conservation issues facing migratory shorebird populations that breed in temperate regions and use wetlands in the non-breeding season. Shorebirds are excellent model organisms for understanding ecological, behavioural and evolutionary processes and are often used as indicators of wetland health. A global team of experienced shore-bird researchers identified 45 issues facing these shorebird populations, and divided them into three categories (natural, current anthropogenic and future issues). The natural issues included megatsunamis, volcanoes and regional climate changes, while current anthropogenic threats encompassed agricultural intensification, conversion of tidal flats and coastal wetlands by human infrastructure developments and eutrophication of coastal systems. Possible future threats to shorebirds include microplastics, new means of recreation and infectious diseases. We suggest that this review process be broadened to other taxa to aid the identification and ranking of current and future conservation actions.

Murray NJ, Phinn SR, Clemens RS, Roelfsema CM, Fuller RA. 2012. Continental Scale Mapping of Tidal Flats across East Asia Using the Landsat Archive. *Remote Sensing* **4,** 3417-3426.

(Abstract)

Tidal flats provide habitat for biodiversity, protection from storm surges and sea level rise, and a range of other ecosystem services. However, no simple method exists for mapping tidal flats over large (>1,000 km) extents, and consequently their global status and distribution remain poorly understood. Existing mapping methods are restricted to small areas with known tidal regimes because tidal flats are only fully exposed for a brief period around low tide. Here we present a method for mapping tidal flats over very large areas and demonstrate its utility by mapping the tidal flats of China, the Democratic People's Republic of Korea and the Republic of Korea. We (i) generated tide height predictions at the acquisition time of all Landsat Archive images of our study area using a validated regional tide model, (ii) selected suitable images acquired in the upper and lower 10% of the tidal range, (iii) converted high and low tide images to a land and water class image derived from the Normalized Differenced Water Index (NDWI) and, (iv) subtracted the high tide classified image from the low tide classified image, resulting in delineation of the tidal flat. Using this method, we mapped the tidal flats for 86.8% of the study area coastline (13,800 km). A confusion matrix for error assessment indicated an accuracy of >85% for the resulting tidal flat map. Our method enables coastal morphology to be mapped and monitored at continental scales, providing critical data to inform coastal adaptation measures for sea level rise, for monitoring coastal habitat loss and for developing ecosystem-based coastal conservation measures.

McKinnon L, Picotin M, Bolduc E, Juillet C, Bêty J. 2012. Timing of breeding, peak food availability, and effects of mismatch on chick growth in birds nesting in the High Arctic. *Canadian Journal of Zoology* **90,** 961-971.

(Abstract)

In seasonal environments, breeding events must be synchronized with resource peaks to ensure production and growth of offspring. As changes in climate may affect trophic levels differentially, we hypothesized that a lack of synchrony between chick hatch and resource peaks could decrease growth rates in chicks of shorebirds nesting in the High Arctic. To test this hypothesis, we compared growth curves of chicks hatching in synchrony with peak periods of food abundance to those hatching outside of these peak periods. We also tested for changes in lay dates of shorebirds in the Canadian Arctic using recent and historical data. Mean daily temperatures during the laying period increased since the 1950s by up to 1.5 °C, and changes in lay dates were apparent for three shorebird species, yet differences in median lay dates between 1954 and 2005–2008 were only significant for White-rumped Sandpiper (*Calidris fuscicollis* (Viellot, 1819)). During 2005–2008, there was only 1 year of relatively high synchrony between hatch and resource peaks. Asynchrony between hatch and peaks in Tipulidae biomass reduced growth rates in chicks of Baird's Sandpiper (*Calidris bairdii* (Coues, 1861)). As anticipated changes in climate may decouple phenological events, the effects of asynchrony on growth rates of arctic-nesting birds warrant further investigation.

Van Roomen M, Laursen K, van Turnhout C, van Winden E, Blew J, Eskildsen K, Günther K, Hälterlein B, Kleefstra R, Potel P, Schrader S, Luerssen G, Ens BJ. 2012. Signals from the Wadden sea: Population declines dominate among waterbirds depending on intertidal mudflats. *Ocean & Coastal Management* **68,** 79-88.

(Abstract)

The Wadden Sea, shared by Denmark, Germany and the Netherlands, is one of the world's largest intertidal wetlands. Waterbirds are an important element of the Wadden Sea ecosystem. By their migratory behaviour they connect the Wadden Sea with other sites, ranging from the arctic to the western seaboards of Europe and Africa, forming the East-Atlantic Flyway. The Joint Monitoring of Migratory Birds (JMMB) project of the Trilateral Monitoring and Assessment Program (TMAP) follows the changes in population size within the Wadden Sea. In this paper we describe and analyse population trends over the years 1991e2009 for 22 waterbird species using the Wadden Sea in internationally important numbers and depending on intertidal mudflats. Population declines predominated in this 18-year period. More populations decreased in Schleswig-Holstein and Niedersachsen than in The Netherlands and Denmark. This is the case particularly for species feeding on polychaetes. In contrast, waterbirds feeding on bivalves are in decline in all regions except Denmark. On the finer spatial scale of tidal basins, these patterns in trends are still apparent, although much variation in trend directions exists within the Dutch Wadden Sea, especially in bivalve specialists. For those species for which we could compare the trend in theWadden Sea with the trend of their entire flyway population, we found that the former were more negative. This finding and the contrasting trends between regions and tidal basins within the Wadden Sea suggest that causes of the population changes are to be sought within the Wadden Sea itself. These causes, which may act in combination, could be related to factors operating within the Wadden Sea only or with factors operating on a larger scale but having an intensified or differentiated effect within the Wadden Sea. Interestingly, the Wadden Sea regions where negative trends of benthivorous waterbirds predominate are characterized by a large tidal amplitude, whereas areas where bird numbers have generally increased are characterized by a small tidal amplitude. An inventory of possible causes indicated climate change, eutrophication, shellfish fisheries, invasive species and increasing numbers of avian predators as the most important candidates to be investigated further to explain the observed trends.

Masi BP, Zalmon IR. 2012. Intra-annual variation of intertidal benthic community in a breakwater zone on the north coast of Rio de Janeiro, Brazil. *Community Ecology* **13,** 137-144.

(Abstract)

The present study investigated the vertical distribution of intertidal benthic organisms in different periods of the year, relating them to environmental variables (tide, air temperature, wave height and period) on a breakwater zone on the northern coast of Rio de Janeiro State. Quadrats of 400 cm2 were superposed along four vertical profiles and sampled by a photoquadrat method. A seasonal difference was identified in the degree of air exposure, which was higher in October 2005 and February 2006. Air temperature and wave height and periodicity differed significantly among the four studied periods. Some species occurred only in one period as *Fissurella clenchi* in July 2005 and October 2005, *Gracilaria domingensis*in July 2005, *Grateloupia* sp. in October 2005) and *Porphyra acanthophora* in October 2005 and February 2006. Species richness and diversity values were higher in the intermediary quadrats in all the studied periods. The intermediate benthic strip occupied a narrower zone, changing its spatial location according to the season of the year: in May 2005 it was closer to the lower zone, in July and October 2005 it occupied an intermediate position, and in February 2006 it was nearest to the upper quadrats. The hypothesis of intra-annual variation of the benthic community distribution according to the seasonal variability of tides, air temperatures, wave height and periodicity was accepted for the intermediate strip of the intertidal zone, related to taxonomic differences and on the abundance of dominant species considering the four studied seasons.

Threats 2011

Catry T, Alves JA, Andrade J, Costa H, Dias MP, Fernandes P, Leal A, Lourenço PM, Martins RC, Moniz F, Pardal S, Rocha A, Santos CD, Encarnação V, Granadeiro JP. 2011. Long-term declines of wader populations at the Tagus estuary, Portugal: a response to global or local factors? *Bird Conservation International* **21,** 438-453.

(Abstract)

Migratory wader populations face global threats, mainly related to increasing rates of habitat loss and disturbance driven by human activities. To a large extent, the long-term survival of these populations requires the conservation of networks of sites along their migratory flyways. The Tagus estuary, Portugal, is among the most important wetlands for waders in the East Atlantic Flyway. Annual winter wader counts have been carried in this wetland since 1975 and a monthly roost-monitoring programme was implemented in 2007. Wintering populations of three out of the five most abundant species, Dunlin *Calidris alpina*, Grey Plover *Pluvialis squatarola* and Redshank *Tringa totanus,* showed significant population declines over the past three decades, which are most likely due to the loss and degradation of roost sites as a result of increasing human activity. The situation is unlikely to improve, as a high proportion of the wintering waders use roost sites that are situated in highly urbanised areas with no legal protection. The use of different roost sites by waders is highly variable both temporally and spatially, thus emphasizing the need for a network of good quality roost sites. Additionally,

during migration, 60–80% of all the waders of the Tagus estuary concentrate at a single refuge, thus increasing the risk for wader populations during these periods.

Bi X, Wang B, Lu Q. 2011. Fragmentation effects of oil wells and roads on the Yellow River Delta, North China. *Ocean & Coastal Management* **54,** 256-264.

(Abstract)

Oil exploitation and road development have strongly fragmented the coastal landscapes, leading to profound ecological consequences. The dynamic relationships between oil wells, roads, and landscape fragmentation indices in the Yellow River Delta, China were explored. Oil wells, roads and land cover were mapped from TM images in 1992, 2000, 2006, and 2009, respectively. Changes and relationships were compared among three selected typical sections using linear regression models. We also evaluated the fragmentation effects of oil exploitation on protected wetlands in the Yellow River Delta Natural Reserve (NR). The results showed that oil wells and roads increased greatly. Oil well density and road length density were positively related to patch number and negatively related to patch shape indices. Both drivers have cumulative effects on landscape fragmentation. Influences of old oil wells and roads were stronger than those of new ones. Current management strategies of the NR have failed to effectively prohibit the disturbances of oil activities at the regional scale. The ecological function of protected wetland systems has been damaged by the increase of oil wells. Therefore, based on the principles of landscape ecology, effective approaches were proposed to minimize the negative effects of oil exploitation on the coastal area.

Barshep Y, Hedenström A, Underhill LG. 2011. Impact of Climate and Predation on Autumn Migration of the Curlew Sandpiper. *Waterbirds* **34,** 1-9.

(Abstract)

Using constant-effort catch data, causes of annual variation in the timing of migration of Curlew Sandpipers (*Calidris ferruginea*) migrating through Ottenby, Sweden, as well as the trend in timing of migration from 1946-2005, was investigated. Variation in the timing of autumn migration of adult and juvenile Curlew Sandpipers was influenced by breeding success connected to predation pressure on the Arctic breeding grounds. Median migration date of adult birds was significantly later in good breeding years compared with poor breeding years while the migration of juveniles was earlier in good breeding years compared with poor breeding years. Also, adults migrated earlier when the average temperature in June was warmer. Median migration dates of adults have advanced by 23 days from 1946-2005, but the migration dates of juveniles have remained unchanged. Unchanged migration dates of juveniles indicate that earlier departure of the adult Curlew Sandpipers from the breeding

grounds was not due to earlier breeding. Evidence suggests that declining breeding productivity as a result of increasing predation on broods of shorebirds might, over the years, be the reason for the observed pattern of early departure of adults from the breeding grounds. One possible consequence of earlier migration is a mismatch between timing of migration and periods of food abundance on migration routes and at the wintering grounds, leading to a decline in adult and juvenile survival and population size.

De Boer WF, Cao L, Barter MA, Wang X, Sun MM, van Oeveren H, de Leeuw J, Barzen J, Prins HHT. 2011. Comparing the Community Composition of European and Eastern Chinese Waterbirds and the Influence of Human Factors on the China Waterbird Community. *Ambio* **40,** 68–77.

(Abstract)

We compared the European and eastern Chinese waterbird assemblages and checked whether the effects of human disturbance could be detected in the assemblages' composition. For the different Chinese provinces, we expected to find a negative effect of economic development on the mean bird species mass and on the proportion of bentivorous, piscivorous and insectivorous bird species. We also expected to find relatively fewer large species in the Chinese assemblage. Species rank–abundance curves were relatively similar, but China had significantly more species with smaller body masses. The China assemblage was characterized by relatively higher abundance of heavy-bodied species, contrary to our expectations. Mean bird body mass decreased in China with increasing disturbance and increasing gross domestic product (GDP). For coastal provinces in China the percentage of bentivorous, piscivorous and insectivorous bird species declined with increasing GDP, maybe through the increased use of pesticides or fertilizer.

Threats 2010 and earlier

2010

Traill, L. W., C. J. A. Bradshaw, S. Delean, and B. W. Brook. 2010. Wetland conservation and sustainable use under global change: a tropical Australian case study using magpie geese. *Ecography* **33**:818-818.

(Abstract)

Imminent shifts in environmental parameters due to climatic change might have profound ramifications for wetlands listed under the Ramsar convention. Although the exact

mechanisms by which global change will affect these systems are not known, models that simulate component drivers, particularly at a broad spatial scale, can nevertheless allow for more informed conservation decision making. Such general inference is particularly needed for wetlands across the tropics, where less knowledge and fewer resources are available to mitigate the impacts on important conservation sites. Here we develop a case study of wetland loss to sea level rise across tropical north Australia (including Ramsar-listed sites), and link these to a metapopulation model for a keystone endemic waterbird, the magpie goose *Anseranas semipalmata*. We projected published models on sea level rise through to the year 2400, and found a non-linear trajectory of inundation up to 20 m above present levels. Digital elevation models were used to simulate sea level rise and the spatially differentiated loss of wetland habitat used by geese. Range retraction was linked to decline in ecological carrying capacity, and we coupled wetland-specific habitat loss projections to a spatially explicit demographic metapopulation model. Additionally, we included alternate harvest strategies based on present-day estimates of indigenous and non-indigenous offtake of geese, and examined the synergy between wetland loss and hunting on extinction risk. Our results suggest that Australia's once-abundant and widespread magpie goose will be reduced to a fragmented population of just a few thousand individuals within the next 200-300 yr. Harvest could continue for some time, up to a ''tipping point'' at around 5% loss of current wetland habitat, after which the decline of geese is rapid. Given the inexorable nature of sea level rise, short- to medium-term conservation of waterbirds across Ramsar wetlands must prepare for adaptive wetland management, such as through buffer-placement, and ongoing monitoring of harvest.

Purnama S, Indrawan M. 2010. Entrapment of wetland birds: local customs and methods of hunting in Krangkeng, Indramayu, Central Java. In 'Ethno-Ornithology: birds, indigenous peoples, culture and society'. (Eds SC Tidemann and A Gosler), Earthscan. pp. 67-72.

(Abstract)

Hunting of birds in the wetlands of Krangkeng (central Java) has expanded from small-scale subsistence level to sales in markets. In spite of self-imposed limits by hunters in relation to trapping method used and certain hunting taboos, populations of wetland birds have declined. Alternative methods of income generation for local people, such as ecotourism, and paid roles in pest and disease surveillance, need to be supplemented by increased agricultural training and productivity, community organization and education if bird populations are to recover. For centuries, people in Indonesia have hunted birds to satisfy their personal need for food as well as to sell, on a small scale, in the local marketplace, with consequent income for the vendors to enable them to gain the basic necessities of life. Given the huge geographical, cultural and environmental diversity present in Indonesia, it is to be expected that people differ in their attitudes towards, and utilization of, birds across the archipelago. It is also possible that the changing nature of the economy is forcing a change in the nature of the relationship between birds and humans.

Chowdhury SU. 2010. Preliminary survey of shorebird hunting in five villages around Sonadia Island, Cox's Bazar, Bangladesh. *Birding ASIA* **14**, 101–102.

(No abstract available)

2009

Gan, X., Y. Cai, C. Choi, Z. Ma, J. Chen, and B. Li. 2009. Potential impacts of invasive *Spartina alterniflora* on spring bird communities at Chongming Dongtan, a Chinese wetland of international importance. Estuarine, *Coastal and Shelf Science* **83**:211–218.

(Abstract)

Invasive smooth cordgrass (*Spartina alterniflora*, hereafter *Spartina*) has been expanding rapidly in the estuarine wetlands at Chongming Dongtan (East China) at the expense of native sea-bulrush (*Scirpus mariqueter*, hereafter *Scirpus*) and common reed (*Phragmites australis*, hereafter *Phragmites*). To examine the potential impacts of the *Spartina* invasion on bird diversity, we compared the abundance and species richness of birds in habitats created by *Spartina*, *Phragmites*, *Spartina* mixed with *Phragmites*, *Scirpus*, and the bare intertidal zone at Chongming Dongtan in spring 2008. Most birds were recorded in the native habitats, with songbirds and breeding birds being most abundant in the *Phragmite s*habitats, and waterbirds and migrants being most abundant in the *Scirpus* habitats and bare intertidal zone. Both species number and population densities of birds were lower in the exotic *Spartina* habitats than in the other four habitats. Although some songbirds and breeding birds used the *Spartina*-invaded habitats, and even preferred *Spartina*-invaded habitats to *Scirpus* habitats and bare intertidal zone, their densities were lower in the *Spartina*-invaded habitats than in the native *Phragmites* habitats. This might have resulted from the dense *Spartina* stands restricting bird movement and providing insufficient useable food for most birds. We conclude that the spread of exotic *Spartina* has negative impacts on local bird communities. Because Chongming Dongtan is an important stopover site for energy replenishment of shorebirds in the East Asian–Australasian Flyway, urgent measures are needed to control further spread of *Spartina* and to restore the native habitats for birds.

2008

Drewitt AL, Langston RHW. 2008. Collision Effects of Wind-power Generators and Other Obstacles on Birds. *Annals of the New York Academy of Sciences* **1134,** 233-266.

(Abstract)

There is extensive literature on avian mortality due to collision with man-made structures, including wind turbines, communication masts, tall buildings and windows, power lines, and fences. Many studies describe the consequences of bird-strike rather than address the causes, and there is little data based on long-term, standardized, and systematic assessments. Despite these limitations, it is apparent that bird-strike is a significant cause of mortality. It is therefore important to understand the effects of this mortality on bird populations. The factors which determine avian collision risk are described, including location, structural attributes, such as height and the use of lighting, weather conditions, and bird morphology and behavior. The results of incidental and more systematic observations of bird-strike due to a range of structures are presented and the implications of collision mortality for bird populations, particularly those of scarce and threatened species susceptible to collisions, are discussed. Existing measures for reducing collision mortality are described, both generally and specifically for each type of structure. It is concluded that, in some circumstances, collision mortality can adversely affect bird populations, and that greater effort is needed to derive accurate estimates of mortality levels locally, regionally, and nationally to better assess impacts on avian populations. Priority areas for future work are suggested, including further development of remote technology to monitor collisions, research into the causes of bird-strike, and the design of new, effective mitigation measures.

2007

Kim J, Park S-K, Koo T-H. 2007. Lead and cadmium concentrations in shorebirds from the Yeongjong Island, Korea. *Environmental Monitoring and Assessment* **134**, 355-361.

(Abstract)

This study presents concentration levels of pollutants (lead, and cadmium) in tissues (livers, kidneys, muscles, and bones) of shorebirds (Kentish Plovers (n=5), Mongolian Plovers (n=2), Dunlins (n=6), Great Knots (n=10), Terek Sandpipers (n=10)) from Yeongjong Island, Korea in the East Asian–Australian migration flyways during the autumn migration in 1994–1995. Lead concentrations in livers, in kidneys, in muscles, and in bones were significantly different among shorebird species. Lead concentrations in livers of Kentish Plovers (4.76±2.72 μg/wet g), Mongolian Plovers (2.05 μg/wet g), Dunlins (3.77±1.07 μg/wet g), and Great Knots (4.27±3.19 μg/wet g) were less than the toxic level, and lead concentrations in livers of Terek Sandpipers (1.20±0.94 μg/wet g) were at the background level. Cadmium concentrations in livers, in kidneys, in muscles, and in bones did not vary among shorebirds, and concentrations of cadmium in livers and in kidneys were at background level (respectively, approximate 1 μg/wet g, approximate 2.67 μg/wet g) in all shorebird species. We suggest that interspecific differences of lead and cadmium concentrations were attributed to differences in exposure time and differences of diet, microhabitats in wintering ground. In livers and kidney of shorebirds from Yeongjong Island, lead and cadmium concentrations were higher than other locations previously reported.

2006

Goss-Custard, J. D., P. Triplet, F. Sueur, and A. D. West. 2006. Critical thresholds of disturbance by people and raptors in foraging wading birds. *Biological Conservation* **127**:88-97.

(Abstract)

Intertidal areas support during the non-breeding season many wading birds Charadrii that may often take flight in response to the presence of people or of birds of prey on their intertidal feeding and roosting grounds. Disturbance can cause birds to spend energy flying away and to lose feeding time while relocating to different feeding areas, where the increased bird densities may intensify competition from interference and, if of sufficient duration, from prey depletion. Until now, there has been no method for establishing how frequently birds can be put to flight before their fitness is reduced. We show how individual-based behavioural models can establish critical thresholds for the frequency with which wading birds can be disturbed before they die of starvation. It uses oystercatchers *Haematopus ostralegus* in the baie de Somme, France where birds were put to flight by disturbance up to 1.73 times/daylight hour. Modelling shows that the birds can be disturbed up to 1.0–1.5 times/h before their fitness is reduced in winters with good feeding conditions (abundant cockles *Cerastoderma edule* and mild weather) but only up to 0.2–0.5 times/h when feeding conditions are poor (scarce cockles and severe winter weather). Individual-based behavioural models enable critical disturbance thresholds to be established for the first time.

Lee, S. Y., R. J. K. Dunn, R. A. Young, R. M. Connolly, P. E. R. Dale, R. Dehayr, C. J. Lemckert, S. Mckinnon, B. Powell, P. R. Teasdale, and D. T. Welsh. 2006. Impact of urbanization on coastal wetland structure and function. *Austral Ecology* **31**:149–163.

(Abstract)

Urbanization is a major cause of loss of coastal wetlands. Urbanization also exerts significant influences on the structure and function of coastal wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. Natural coastal wetlands are characterized by a hydrological regime comprising concentrated flow to estuarine and coastal areas during flood events, and diffused discharge into groundwater and waterways during the non-flood periods. Urbanization, through increasing the amount of impervious areas in the catchment, results in a replacement of this regime by concentrating rain runoff. Quality of runoff is also modified in urban areas, as loadings of sediment, nutrients and pollutants are increased in urban areas. While the effects of such modifications on the biota and the physical environment have been relatively well

studied, there is to date little information on their impact at the ecosystem level. Methodological issues, such as a lack of sufficient replication at the whole-habitat level, the lack of suitable indices of urbanization and tools for assessing hydrological connectivity, have to be overcome to allow the effects of urbanization to be assessed at the ecosystem level. A functional model is presented to demonstrate the impact of urbanization on coastal wetland structure and function.

Trail, P. W. 2006. Avian Mortality at Oil Pits in the United States: A Review of the Problem and Efforts for Its Solution. *Environmental Management* **38**:532–544.

(Abstract)

Oil production operations produce waste fluids that may be stored in pits, open tanks, and other sites accessible to wildlife. Birds visit these fluid-filled pits and tanks (‘‘oil pits’’), which often resemble water sources, and may become trapped and die. The US Fish and Wildlife Service (USFWS) has a program to reduce these impacts by locating problem pits, documenting mortality of protected wildlife species, and seeking cleanup or corrective action at problem pits with the help of state and federal agencies regulating the oil industry. Species identification and verification of protected status for birds recovered from oil pits are performed at the USFWS National Fish and Wildlife Forensics Laboratory. From 1992 to 2005, aminimum of 2060 individual birds were identified from remains recovered from oil pits, representing 172 species from 44 families. The taxonomic and ecological diversity of these birds indicates that oil pits pose a threat to virtually all species of birds that encounter them. Ninety-two percent of identified bird remains belonged to protected species. Most remains identified at the Forensics Laboratory were from passerines, particularly ground-foraging species. Based on Forensics Laboratory and USFWS field data, oil pits currently cause the deaths of 500,000–1 million birds per year. Although law enforcement and industry efforts have produced genuine progress on this issue, oil pits remain a significant source of mortality for birds in the United States.

Drewitt AL, Langston RHW. 2006. Assessing the impacts of wind farms on birds. *Ibis* **148,** 29-42.

(Abstract)

The potential effects of the proposed increase in wind energy developments on birds are explored using information from studies of existing wind farms. Evidence of the four main effects, collision, displacement due to disturbance, barrier effects and habitat loss, is presented and discussed. The consequences of such effects may be direct mortality or more subtle changes to condition and breeding success. The requirements for assessing the impact of future developments are summarized, including relevant environmental legislation and

appropriate methods for undertaking baseline surveys and post-construction monitoring, with particular emphasis on the rapidly developing area of offshore wind farm assessments. Mitigation measures which have the potential to minimize impacts are also summarized. Finally, recent developments in the monitoring and research of wind energy impacts on birds are outlined and some areas for future work are described.

Collision risk and mortality

Langston RHW, Pullan JD. 2006. 'Effects of wind farms on birds.' Convention on the Conservation of European Wildlife and Habitats (Bern Convention).

(Abstract)

This report analyses the impact of windfarms on birds, establishing criteria for their environmental impact assessment and developing guidelines on precautions to be taken when selecting sites for windfarms.

The impact of windfarms on birds:

A review of the literature identified the main potential hazards to birds from windfarms to be:

– disturbance leading to displacement or exclusion, including barriers to movement;

– collision mortality;

– loss of, or damage to, habitat resulting from wind turbines and associated infrastructure.

There have been few comprehensive studies, and even fewer published, peer-reviewed scientific papers. Many studies suffer from a lack of before and after, or windfarm area and reference area comparisons, or a total lack of assessment of relevant factors, such as collision/collision risk, differences in bird behaviour between night and day, or are inadequate duration to provide conclusive results. In some cases, the reason for the short timescale is that studies are in their early stages and so there may be further information available in the future.

It is clear that there is a need for robust, objective baseline studies to inform sensitive siting to minimise deleterious effects on birds, other wildlife and their habitats, and a need for post construction monitoring at consented installations where there are environmental sensitivities. There is clearly a distinction to be made between effects of a temporary versus a permanent nature. There is also a need to put into context the potential impacts to determine the spatial scales at which they may apply, e.g. site, local, regional, national and/or international.

Disturbance

The effects attributable to windfarms are variable and are species-, season- and site-specific. Disturbance can lead to displacement and exclusion from areas of suitable habitat, effectively loss of habitat for the birds.

There are several reliable studies indicating negative effects up to 600 m from wind turbines, i.e. a reduction in bird use of, or absence from, the area close to the turbines, for some species (e.g. whooper swan Cygnus cygnus, pink-footed goose Anser brachyrhynchus, European white-fronted goose A. albifrons, Eurasian curlew Numenius arquata). In a large windfarm, even this relatively small exclusion area around an individual turbine may amount to a cumulatively significant exclusion area, or area of reduced use, even within a single windfarm.

The scale of such habitat loss, together with the extent of availability and quality of other suitable habitats that can accomodate displaced birds, and the conservation status of those birds, will determine whether or not there is an adverse impact.

Habituation may occur, cf. observed differences in behaviour between residents and migrants in some studies, but studies over several years of eagles in California provide little indication of habituation and few other studies have been of long enough duration to demonstrate whether or not habituation occurs.

Disturbance potentially may arise from increased human activity in the vicinity of windfarms, e.g. during construction, maintenance visits, facilitation of access via access roads, often in areas of little human activity before the arrival of a windfarm. The presence/noise of turbines may also deter birds from using the area close to turbines. Few studies are conclusive in their findings, often because of a lack of well-designed studies both before and after construction of the windfarm. Furthermore, very few studies take account of differences in diurnal and nocturnal behaviour, basing assessments on daytime only, which is inadequate for those species which are active during darkness and which may behave differently at night compared with during the day.

There is some indication that wind turbines may be barriers to bird movement. Instead of flying between the turbines, birds may fly around the outside of the cluster. Whether this is a problem will depend on the size of the windfarm, spacing of turbines, the extent of displacement of flying birds and their ability to compensate for increased energy expenditure. The cumulative effects of large windfarm installations may be considerable if bird movements are consequently displaced. This may lead to the disruption of ecological links between feeding, breeding and roosting areas.

Windfarm design may alleviate any barrier effect, for example allowing wide corridors between clusters of turbines. Research and post-construction monitoring at several pilot sites will be necessary to determine whether and where this is an acceptable solution.

The wind energy industry is in its infancy offshore and, consequently, there has been little research into the impacts on birds. Nonetheless, there are useful studies underway, especially in The Netherlands and Denmark, indicating a variable response that is both site- and species-specific, just as onshore. The proposals for large windfarms in shallow sea areas may conflict with the feeding distributions of seabirds, notably seaducks, if these are dispaced due to disturbance and consequently excluded from their main feeding areas.The potential cumulative effects of multiple installations are a particular concern.

Collision risk and mortality

The majority of studies have quoted low collision mortality rates per turbine, but in many cases, these are based only on found corpses, leading to under-recording the actual number of collisions. Even where collision rates per turbine are low, this does not necessarily mean that collision mortality is insignificant, especially in windfarms comprising perhaps several hundreds or thousands of turbines. Even relatively small increases in mortality rates may be significant for populations of some birds, especially large, long-lived species with generally low annual productivity and slow maturity, notably so when already rare.

Relatively high collisions mortality rates have been recorded at several large, poorly sited windfarms in areas where large concentrations of birds are present (including Important Bird Areas (IBAs)), especially migrating birds, large raptors or other large soaring species, e.g. Altamont Pass in California, USA, Tarifa and Navarra in Spain. In these cases, actual deaths resulting from collision are high, notably of golden eagle Aquila chrysaetos and griffon vulture Gyps fulvus, respectively.

Collision mortality at poorly sited windfarms may have population level effects, and cumulative mortality from multiple wind installations may also contribute to population decline in susceptible species. Making projections of the potential magnitude of wind turbine-related avian fatalities is problematic because of the frequent lack of objective information.

The weight of evidence to date indicates that locations with high bird use, especially by species of conservation concern, are not suitable for windfarm development (e.g. in Spain, regional recovery plans prohibit windfarms in areas important for breeding and feeding imperial eagles Aquila heliaca). Site selection is crucial to minimising collision mortality. The precautionary principle is advocated where there are concentrations of species of conservation importance. It is therefore very important that alternative locations are proposed for the potentially most hazardous windfarms.

Wind speed and direction, air temperature and humidity, flight type, distance and height, time of day and topography, all influence the risk of collision, as do species, age, behaviour and the stage of the bird's annual cycle. All these factors need to be incorporated in collision risk assesments. Collision risk is greater in poor flying conditions, such as strong winds that affect the birds' ability to control flight manouevres, or in rain, fog, and on dark nights when visibililty is reduced. In these conditions, the flight height of migrating birds tends to be greatly reduced. Lighting of turbines has the potential to attract birds, especially in bad weather, thereby potentially increasing the risk of collision.

Few studies attempt observations in poor weather and visual observations are limited in such conditions. However, remote techniques can be used to extend observations beyond the visible spectrum, e.g. radar, thermal imagery and, at the very least predictions of the likely frequency of the weather conditions that increase collision risk can be used to inform the risk assessment.

Most studies have been of small turbines, often in small clusters; the implications of newer, larger turbines and larger windfarms may be different; The importance of windfarm location and layout in determining the risk of collision by birds with wind turbines is apparent from studies both onshore and offshore.

Collision mortality arises as a result of collision with turbines, meteorological masts and powerlines. Thus, assessment of bird collision risk and mortality, arising from collision or

electrocution, needs to include wind turbines and associated structures, including overhead powerlines transporting energy from the windfarm. It is recognised that the actual rate of collision is likely to be under-recorded, owing to the limitations of the study techniques, particularly corpse searches, so it is essential that calibration is undertaken at each site to enable correction factors to be applied to produce more realistic estimates of collision mortality.

Collision risk models provide a potentially useful means of predicting the scale of collision attributable to wind turbines in a given location, but only if they incorporate actual avoidance rates in response to fixed structures and post-construction assessment of collision risk at windfarms that do proceed, to verify the models. Population models provide a means of predicting whether or not there are likely to be population level impacts arising from collision mortality. Again, they require post-construction verification at consented windfarms to test the validity of the predictions and the models.

Habitat loss or damage

Loss of or damage to habitat, resulting from windfarm infrastructure, is not generally perceived to be a major concern for birds outside designated or qualifying sites of national and international importance for biodiversity, depending on local circumstances and the scale of land-take required for the windfarm and associated infrastructure. The cumulative loss of or damage to sensitive habitats may be significant, especially if multiple, large developments are sited in such locations, e.g. on sandbanks in shallow waters on peatlands. Furthermore, direct habitat loss may be additive to disturbance exclusion.

Onshore infrastructure including turbine bases, substations and access roads etc. will involve direct habitat loss. This is generally fairly small scale, but could affect local hydrology in sensitive habitats and, again, the effects will depend on the size of the windfarm and especially the extent of any road network required.

Offshore, direct habitat loss is generally small-scale, primarity for turbine bases and cables at sea. However, increasingly large windfarms, especially on feeding areas such as sandbanks in shallow water, may give cause for concern and habitat change or damage may be significant.

Turbines may offer roosting or nesting sites for birds. However, research needs to be undertaken to assess the extent of bird use. In the offshore environment, there may be adverse effects on birds as a result of disruption to, or encouragement (collision risk for birds feeding among turbines) of, avian food resources such as benthos and fish populations, for example, as a consequence of the effects of electromagnetic fields around under-sea power cables. These aspects require further study to clarify whether or not there are significant issues of concern.

Environmental assessment and site selection guidelines

Criteria for Environmental Assessment

All windfarm developments require screening and those that have the potential for damaging effects on wild birds or the wider environment, or in areas where there is uncertainty as to the potential effects, require a robust environmental impact assessment (EIA). This needs to include comprehensive environmental impact assessment for individual projects and an

assessment of the cumulative impacts arising from each windfarm proposal (including associated infrastructure onshore and offshore, such as new roads, powerlines, and under-sea cabling) in conjunction with other projects (both other windfarms and other relevant projects).

There is considerable support for wind energy as an environmentally benign source of energy. Nonetheless, stringent environmental assessment is just as important for wind energy as for other developments to ensure that it is sited optimally and to avoid or at least minimise any adverse impacts. Poor quality EIAs, or lack of information, must not be permitted to lead planning approval on the grounds of no demonstrable effect.

Standardised study methods, to ensure comparability, are essential, as is consistency in their application before, during and after constuction, in the windfarm area and a reference area (BACI – Before-After Control-Impact). It is recommended that a minimum one-year baseline field study should be undertaken to determine the use of the study-area by birds and to identify which, if any, species may be adversely affected by windfarm construction. Post-construction monitoring needs to enable short- and long-term effects and impacts to be distinguished and provide the information to enable them to be satisfactorily addressed.

On the basis of the literature review, species' conservation status and more than 10 years collective experience by the BirdLife partners, the following species groups and example species are considered to be particularly sensitive, or potentially so, to windfarm (disturbance displacement, barriers to movement, collision, habitat loss or damage), although in many cases there is lack of impact studies to date. Thus, they are likely to be focal species for detailed environmental assessment and research. This list is indicative rather than comprehensive. There are many species for which there is either no information, or no conclusive information, to date. Focal species are likely to be site and issue specific and may change in the light of further research or change in conservation status.

Precautions for site selection of windfarms

There is a strong consensus that location is critically important to avoid deleterious impacts of windfarms on birds. There should be precautionary avoidance of locating windfarms in statuorily designated or qualifying international (e.g. Natura 2000 – SPAs & SACs, 'Ramsar sites', Emerald Network and Important Bird Areas (IBAs)) or national sites for nature conservation, or other areas with large concentrations of birds, such as migration crossing points, or species identified as being of conservation concern. The favourable conservation status of habitats and species in these areas is a central tenet to their designation, requiring demonstration of compatibility with this aim by any proposed development. The weight of evidence to date indicates that locations with high bird use, especially by protected species, are not suitable for windfarm development.

Adverse impacts on wildlife must be avoided by full evaluation of suitable alternatives, appropriate siting and design.

Recommendations

There is an urgent need for statutory marine protected areas to be identified and designated.

Research and monitoring should be implemented by national governments and the wind energy industry, in consultation with relevant experts, to improve our understanding of the

impacts of windfarms. This will be an iterative process that will inform decision-making, appropriate site selection and windfarm design. The results of research should be published in international scientific journals, including a summary, preferably in English, to ensure wider dissemination.

Research and monitoring requirements encompass the following: effects and potential population level impacts on birds of disturbance displacement, barriers to movement, collision mortality and habitat loss or damage; effectiveness of different windfarm layout and turbine design to provide mitigation.

National governments must undertake Strategic Environmental Assessment (SEA) of all wind energy plans and programmes that have the potential for an adverse effect on wildlife in their country. If there are potential trans-boundary effects, then international co-operation with other governments should be sought when undertaking the SEA. The scale of SEA should be determined by consideration of the likely biological scale of impacts as well as jurisdictional boundaries.

Specifically, these SEAs should include indicative mapping of bird populations, their habitats, flyways and migration routes and an assessment of the plan's probable effects on these, to aid decision making.

As part of effective regional planning, there is a need to identify species and areas of concern, to map potential and no-go locations for wind energy development on the basis of nature conservation concerns, for example avoidance of focal points for migration crossings. This may require the collection of additional information, especially offshore.

There need to be incentives to ongoing technological development to maximise efficiency of wind turbines and to reduce dependency on the limited shallow water habitats offshore.

There is a need for best practice guidance on standard study methods, to inform the EIA process.

This report has not looked in detail at individual case studies to evaluate examples of conflict resolution, case law, or trends in casework throughout the Council of Europe area. This may be a useful subject for further study.

2005

Fang, J., S. Rao, and S. Zhao. 2005. Human-induced long-term changes in the lakes of the Jianghan Plain, Central Yangtze. *Frontiers in Ecology and Evolution* **3**:186-192.

(Abstract)

The Jianghan Plain, located in the Central Yangtze area of China, is famous for its freshwater lakes, but these have undergone dramatic changes in area and number as a result of increasing human activity. We analyze the changes in lakes with an area ≥1 km2 from the 1950s to 1998, using historical land-cover information and remote sensing data. The changes

showed two distinct periods: the 1950s–1978 and 1978–1998. During the former period, the number of lakes fell from 414 to 250 (–39.6%) and total area decreased from 3885.4 km2 to 1839.1 km2 (–52.7%). During the latter period, the number of lakes rose, from 250 to 258 (+3.2%), while the area covered increased from 1839.1 km2 to 2144.4 km2 (+16.6%). The rapid fall in numbers of lakes from the 1950s to 1978 was largely attributed to extensive impoldering (land reclamation through draining techniques), resulting in substantial negative ecological consequences, such as increased flooding and a decline in biodiversity. In contrast, the increase in lake numbers and area from 1978 to 1998 was mainly due to the implementation of government policy prohibiting impoldering along the Yangtze River, and the return of inundated arable lands for aquaculture by local people.

Manville, A. M. 2005. Bird Strikes and Electrocutions at Power Lines, Communication Towers, and Wind Turbines: State of the Art and State of the Science – Next Steps Toward Mitigation., USDA Forest Service Gen. Tech. Rep. PSW-GTR-191.

(Abstract)

Migratory birds suffer considerable human-caused mortality from structures built to provide public services and amenities. Three such entities are increasing nationwide: communication towers, power lines, and wind turbines. Communication towers have been growing at an exponential rate over at least the past 6 years. The U.S. Fish and Wildlife Service is especially concerned about growing impacts to some 836 species of migratory birds currently protected under the Migratory Bird Treaty Act of 1918, as amended. While mortality estimates are often sketchy, and won't be verified until nationwide cumulative impact studies are conducted, current figures are troubling. Communication towers may kill from 4-50 million birds per year. Collisions with power transmission and distribution lines may kill anywhere from hundreds of thousands to 175 million birds annually, and power lines electrocute tens to hundreds of thousands more birds annually, but these utilities are poorly monitored for both strikes and electrocutions. More than 15,000 wind turbines may kill 40,000 or more birds annually nationwide, the majority in California. This paper will address the commonalities of bird impacts among these industries; those bird species that tend to be most affected; and research (completed, current, and proposed) intended to reduce bird collisions and electrocutions nationwide. The issues of structure location (siting), lighting, guy supports, lattice or tubular structures, bird behavior, and habitat modifications are reviewed. In addition, this paper reviews the respective roles and publications of the Avian Power Line Interaction Committee and the Wildlife Workgroup of the National Wind Coordinating Committee, the roles of the Service-chaired Communication Tower Working Group and Wind Turbine Siting Working Group, and the Fish and Wildlife Services' voluntary tower and turbine siting and placement guidelines. An update on recent Communication Tower Working Group research initiatives will also be discussed along with promising research findings and needs.

Prudente, M., S. Tanabe, T. Kunisue, G. Tasunaga, I. Watanabe, and N. Miyazaki. 2005. Accumulation of trace elements and persistent organochlorines in resident and migratory waders from Calatagan Bay, Philippines. *Coastal Marine Science* **29**:133-140.

(Abstract)

Concentrations of V, Cr, Mn, Co, Cu, Zn, Se, Rb, Sr, Mo, Ag, Cd, Sb, Cs, Ba, Hg, Tl and Pb were determined in the liver of six species of resident and migratory waders collected in December 1997 from Calatagan Bay, Philippines. Renal Cd concentrations in these species were also determined. Trace element levels were observed to have either decreased or remained intact in the winter, suggestive that trace element burdens for migratory waders could be minimal during wintering. It seems that the migration disctance of waders is a dominant factor in the accumulation of toxic elements such as Cd, Hg and Pb. Hepatic Cd concentrations of pintail snipe are likely to be in critical levels. While concentrations of persistent organochlorines such as PCBs, DDTs, HCHs, CHLs and HCB were determined in the whole bodies and adipose tissues of migratory and resident waders collected in April and December 1994. Accumulation patterns of OCs found in resident birds suggested that PCBs and CHLs were the predominant contents. Among the OCs, it was noted that migratory birds retained mostly high concentrations of DDTs. This finding could be reflective of the presence of these contaminants in the stopover and breeding/wintering ground of these waders in China and Russia. Whereas residual concentrations found in resident birds reflect the pollution status of the sampling area, those found in migratory waders reflect both the pollution status of the sampling area and their migratory routes. Waders are therefore useful bioindicators to elucidate the contamination status of toxic metals and organochlorines in breeding grounds, stopover sites and wintering grounds.

Desholm M, Kahlert J. 2005. Avian collision risk at an offshore wind farm. *Biology Letters* **1**, 296–298.

(Abstract)

We have been the first to investigate whether long-lived geese and ducks can detect and avoid a large offshore wind farm by tracking their diurnal migration patterns with radar. We found that the percentage of flocks entering the wind farm area decreased significantly (by a factor 4.5) from pre-construction to initial operation. At night, migrating flocks were more prone to enter the wind farm but counteracted the higher risk of collision in the dark by increasing their distance from individual turbines and flying in the corridors between turbines. Overall, less than 1% of the ducks and geese migrated close enough to the turbines to be at any risk of collision.

Gill AB. 2005. Offshore Renewable Energy: Ecological Implications of Generating Electricity in the Coastal Zone. *Journal of Applied Ecology* **42,** 605-615.

(Abstract)

1. Global-scale environmental degradation and its links with non-renewable fossil fuels have led to an increasing interest in generating electricity from renewable energy resources. Much of this interest centres on offshore renewable energy developments (ORED). The large scale of proposed ORED will add to the existing human pressures on coastal ecosystems, therefore any ecological costs and benefits must be determined.

2. The current pressures on coastal ecology set the context within which the potential impacts (both positive and negative) of offshore renewable energy generation are discussed.

3. The number of published peer-review articles relating to renewable energy has increased dramatically since 1991. Significantly, only a small proportion of these articles relate to environmental impacts and none considers coastal ecology.

4. Actual or potential environmental impact can occur during construction, operation and/or decommissioning of ORED.

5. Construction and decommissioning are likely to cause significant physical disturbance to the local environment. There are both short- and long-term implications for the local biological communities. The significance of any effects is likely to depend on the natural disturbance regime and the stability and resilience of the communities.

6. During day-to-day operation, underwater noise, emission of electromagnetic fields and collision or avoidance with the energy structures represent further potential impacts on coastal species, particularly large predators. The wider ecological implications of any direct and indirect effects are discussed.

7. Synthesis and applications. This review demonstrates that offshore renewable energy developments will have direct and, potentially, indirect consequences for coastal ecology, with these effects occurring at different scales. Ecologists should be involved throughout all the phases of an ORED to ensure that appropriate assessments of the interaction of single and multiple developments with the coastal environment are undertaken.

2002

Burton, N. H. K., M. M. Rehfisch, and N. A. Clark. 2002. Impacts of disturbance from construction work on the densities and feeding behavior of waterbirds using the intertidal mudflats of Cardiff Bay, UK. *Environmental Management* **30**:865-871.

(Abstract)

The impact of disturbance from construction work around Cardiff Bay, south Wales, on the

densities and feeding behavior of seven waterbird species was studied over an 11-year period. Construction of a barrage across the mouth of the bay has subsequently resulted in its impoundment; other major works included the construction of a bridge carrying a divided highway. Construction work disturbance significantly reduced the densities of five species – green-winged teal (*Anas crecca*), Eurasian oystercatcher (*Haematopus ostralegus*), dunlin (*Calidris alpina*), Eurasian curlew (*Numenius arquata*) and common redshank (*Tringa totanus*) – on adjacent intertidal mudflats, and thus the overall carrying capacity of the bay. Construction work also reduced the feeding activity of Eurasian oystercatcher, dunlin and common redshank on these mudflats. The possible impact of the loss of birds from these mudflats upon the populations that the bay supported is discussed. Evidence from other local studies suggests that the displacement of common redshank from these mudflats did not contribute to a decline in this species.

1997

Fox, A. D., and J. Madsen. 1997. Behavioural and Distributional Effects of Hunting Disturbance on Waterbirds in Europe: Implications for Refuge Design. *Journal of Applied Ecology* **34**:1-13.

(Abstract)

1. Based on studies of effects of hunting disturbance on local waterbird distribution and abundance, freedom from such disturbance is concluded to be an important part of waterbird management on nature conservation areas. Measures to mitigate the effects of disturbance from hunting are reviewed. These include complete removal of hunting in refuges, as well as spatial and temporal regulation of hunting activity in reserve areas outwith hunting-free refuges.
2. Disturbance-free refuge design should take account of the ecological requirements of all species using a site and the functional units required to meet all daily activities, especially primary feeding and roosting areas used by waterbirds. Refuge size and shape must ensure birds are free from the effects of external disturbance. The most effective are of regular shape, maximum practicable size, and as a minimum should have a diameter of three times the escape flight distance of the most sensitive species present.
3. Zoning in non-refuge areas can increase local bird numbers by restricting disturbance to regular predictable stimuli to which habituation is more likely. Mobile hunting activity close to roosting and/or feeding areas is more disturbing than hunting from fixed points or where birds are shot moving between such areas. Intermittent hunting is not an effective means of minimizing disturbance, but where implemented rest periods between hunting events should be considered in weeks rather than days.
4. Most studies of mitigation techniques to minimize hunting disturbance have been descriptive and retrospective. Manipulative studies testing specific hypotheses are essential to create a sound scientific base for management.
5. Management of hunting activity should take place within a broader management planning framework that identifies ideal and operational objectives in the management of the site, including feedback monitoring to determine the effectiveness of management prescriptions.
6. We recommend that local site management planning should be integrated internationally,

especially in the planning of refuge networks along migration corridors. Management actions in one part of a flyway may affect the ability of areas elsewhere to meet obligations to biodiversity conservation and maintenance of range under international law. In populations that are limited by winter resources, creation of a refuge network may offer a mechanism to enhance population size, but more large scale density dependence studies are required to confirm this.

1996

McCarthy J, Noor YR. 1996. Bird Hunting in Krangkeng, West Java: Linking Conservation and Development. *The Journal of Environment Development* **5**, 87-100.

(Abstract)

In developing countries such as Indonesia, the necessity of integrating conservation and development has become somewhat axiomatic. However, working to integrate these two objectives is very difficult. This article considers the problems facing one attempt to do this: a project on the north coast of West Java. Here, along a stretch of coast 5-10 kilometers wide and 60 kilometers long, villagers catch close to 200,000 migratory and resident waterbirds each year. From a conservation perspective, this hunting is putting an unsustainable pressure on many species. For instance, in 1990 researchers estimated that hunting in this area culled about 20% of the world population of oriental pratincoles (*Glarerola maldivarum*). However, given the underdeveloped economy of the area, from the perspective of poor villagers bird hunting is the most rational choice. This case shows the conflict between the conservation values most associated with the West and the survival needs of the poor. We may argue over which has greater value, yet conservation work must deal with the underlying socioeconomic problems facing a large number of marginal people in this region.