

Marine Science Review - 233

Marine and coastal birds

In this review:

- A. Recent articles – no abstract available
- B. Recent articles with abstracts

A. Recent articles – no abstract available

Brown, M. and Hockey, P.A.R. **The status and distribution of African black oystercatchers *Haematopus moquini* in KwaZulu-Natal, South Africa.** *Ostrich* 78(1): 93-96, 2007.

Fraser, G.S., Russell, J., and von Zharen, W.M. **Produced water from offshore oil and gas installations on the grand banks, Newfoundland and Labrador: are the potential effects to seabirds sufficiently known?** *Marine Ornithology* 34(2): 147-156, 2006 [PUBLISHED July 2007].

B. Recent articles with abstracts

Morrison, R.I.G. **Body transformations, condition, and survival in Red Knots *Calidris canutus* travelling to breed at Alert, Ellesmere Island, Canada.** *Ardea* 94(3): 607-618, 2006.

Notes: This paper reviews the nutrient storage dynamics and body changes of Red Knots *Calidris canutus islandica* during migration through their final spring stopover area in Iceland and after arrival on the breeding grounds in the northeastern Canadian High Arctic at Alert. In Iceland, Red Knots not only accumulate large stores of fat and protein, but also undergo extensive morphological changes (increases in 'flight machinery' - flight muscles, heart, fat - and decreases in 'baggage' - stomach, intestines, leg muscles) that leave them well adapted for the flight to the breeding grounds. At Alert, early arrivals have substantial stores of fat and protein remaining. Subsequent body changes involve a rapid loss of these stores and a simultaneous rebuilding of various organs (e.g. restoration of digestive apparatus, development of gonads) which transforms them from a state adapted for flight to one that is suitable for breeding. Stable isotope studies show few of the stores, if any, are used for egg production. The stores could also be used as an energy source for early season survival during food shortage or poor weather. Their major purpose, however, may be to fuel the physical changes needed for breeding. The level of stores acquired at the final stopover during migration can affect survival in several ways. (1) Enhanced survival under difficult conditions: birds captured in Iceland and known to have survived a series of particularly severe summers had been in significantly better condition when caught than birds for which there were no subsequent records. (2) Longer average survival: for previously-banded birds captured in Iceland there was a positive relationship between numbers of summers survived and their condition in Iceland. (3) Reduced survival associated with inadequate stores; in North America, many *rufa* Red Knots passing through the final stopover area in Delaware Bay, USA, were unable to acquire adequate stores in the period 1997-2002 -- this led to a dramatic decrease in annual survival rate, which was enough to account for a 50% decrease in the wintering population in Tierra del Fuego. Failure to maintain adequate habitat and food resources required by Red Knots and other shorebirds at their final spring stopover areas will almost surely lead to reduced reproductive success and survival, and consequent population decline.

Stewart, G.B., Pullin, A.S., and Coles, C.F. **Poor evidence-base for assessment of windfarm impacts on birds.** *Environmental Conservation* 34(1): 1-11, 2007.

Notes: Concerns about anthropogenic climate change have resulted in promotion of renewable energy sources, especially wind energy. A concern raised against widespread windfarm development is that it may negatively impact bird populations as a result of bird collision with turbines, habitat loss and disturbance. Using systematic review methodology bird abundance data were synthesized from 19 globally-distributed windfarms using meta-analysis. The effects of bird taxon, turbine number, power, location, latitude, habitat type, size of area, time since operation, migratory status of the species and quality of evidence were analysed using meta-regression. Although the synthesized data suggest a significant negative impact of windfarms on bird abundance, there is considerable variation in the impact of individual windfarm sites on individual bird species, and it is unclear if the negative impact is a decline in population abundance or a decline in use owing to avoidance. Anseriformes experienced greater declines in abundance than other taxa, followed by Charadriiformes, Falconiformes and Accipitriformes, and Passeriformes. Time since windfarms commenced operation also had a significant impact on bird abundance, with longer operating times resulting in greater declines in abundance than short operating times. Other variables, including turbine number and turbine power either had very weak but statistically significant effects or did not have a significant effect on bird abundance. Windfarms may have significant biological impacts, especially over longer time scales, but the evidence-base is poor, with many studies being methodologically weak, and more long-term impact assessments are required. There is clear evidence that Anseriformes (wildfowl) and Charadriiformes (waders) experience declines in abundance, suggesting that a precautionary approach should be adopted to windfarm development near aggregations of these taxa in offshore and coastal locations. The impact of windfarm developments on bird populations must also be viewed in the context of the possible impact of climate change in the absence of windfarms.

Weston, M.A. and Elgar, M.A. **Responses of incubating hooded plovers (*Thinornis rubricollis*) to disturbance.** *Journal of Coastal Research* 23(3): 569-576, 2007.

Notes: Hooded Plovers (*Thinornis rubricollis*) and recreationists co-occur on the ocean beaches of southern Australia, and it has been suggested that disturbance of the breeding birds by humans constitutes a conservation problem. This study examines whether humans disturb incubating Hooded Plovers and places that disturbance in context with naturally occurring disturbances. Incubating Hooded Plovers encountered and responded to a variety of human and natural stimuli. The most common response involved leaving the nest for a period of time (an "absence"), and humans were responsible for 33.1% of time spent off nests. The response rates of incubating birds varied with the type of stimulus, with higher than expected response rates to two species of potentially predatory birds. About 17% of encounters with potential causes of disturbance occurred while birds were already responding to other disturbance, and this prolonged the return to the nest. Absences from the nest that were not apparently caused by disturbance were shorter and less frequent than those caused by external disturbance stimuli. Nest habitat influenced the response to encounters with humans, and on average foredune nests suffered the greatest decrease in attendance per encounter. This study has confirmed that human disturbance is more frequent than natural disturbances, and that humans decrease nest attendance substantially and more than any other source of disturbance.

Wanless, R.M., Angel, A., Cuthbert, R.J., Hilton, G.M., and Ryan, P.G. **Can predation by invasive mice drive seabird extinctions?** *Biology Letters* 3(3): 241-244, 2007.

Notes: The house mouse, *Mus musculus*, is one of the most widespread and well-studied invasive mammals on islands. It was thought to pose little risk to seabirds, but video evidence from Gough Island, South Atlantic Ocean shows house mice killing chicks of two IUCN-listed seabird species. Mouse-induced mortality in 2004 was a significant cause of extremely poor breeding success for Tristan albatrosses, *Diomedea dabbenena* (0.27 fledglings/pair), and Atlantic petrels, *Pterodroma incerta* (0.33). Population models show that these levels of predation are sufficient to cause population decreases. Unlike many other islands, mice are the only introduced mammals on Gough Island. However, restoration programmes to eradicate rats and other introduced mammals from islands are increasing the number of islands where mice are the sole alien mammals. If these mouse populations are released from the ecological effects of predators and competitors, they too may become predatory on seabird chicks.

Wilhelm, S.I., Robertson, G.J., Ryan, P.C., and Schneider, D.C. **Comparing an estimate of seabirds at risk to a mortality estimate from the November 2004 Terra Nova FPSO oil spill.** *Marine Pollution Bulletin* 54(5): 537-544, 2007.

Notes: On 21 November 2004, about 1000 barrels of crude oil were accidentally released from the Terra Nova FPSO (floating production, storage and offloading) onto the Grand Banks, approximately 340 km east-southeast of St. John's, Newfoundland. We estimated the number of vulnerable seabirds (murre (Uria spp.) and dovekies (Alle alle)) at risk from this incident by multiplying observed densities of seabirds with the total area covered by the slick, estimated at 793 km². A mean density of 3.46 murre/km² and 1.07 dovekies/km² on the sea surface was recorded during vessel-based surveys on 28 and 29 November 2004, with a mean density of 6.90 murre/km² and 13.43 dovekies/km² combining those on the sea and in flight. We calculated a mean of 9858 murre and dovekies were at risk of being oiled, with estimates ranging from 3593 to 16,122 depending on what portion of birds in flight were assumed to be at risk. A mortality model based on spill volume was derived independently of the risk model, and estimated that 4688 (CI 95%: 1905-12,480) birds were killed during this incident. A low mortality estimate based strictly on spill volume would be expected for this incident, which occurred in an area of relatively high seabird densities. Given that the risk and mortality estimates are statistically indistinguishable, we estimate that on the order of 10,000 birds were killed by the Terra Nova spill.

Baudains, T.P. and Lloyd, P. **Habituation and habitat changes can moderate the impacts of human disturbance on shorebird breeding performance.** *Animal Conservation* 10(3): 400-407, 2007.

Notes: Disturbance by humans is widely expected to reduce the reproductive fitness of nesting birds if disturbance reduces nest attentiveness, and unattended eggs experience increased risk of predation or exposure to potentially lethal temperature extremes. Yet, relatively few studies have examined the physiological or behavioural mechanisms whereby disturbance influences reproductive fitness, or the extent to which the costs of disturbance may be reduced through habituation. We compared the behavioural responses, egg temperatures and reproductive success of shore-nesting white-fronted plovers *Charadrius marginatus* to disturbance at two breeding sites experiencing low versus high human recreational activity, respectively. Daytime nest attentiveness decreased with increasing experimental disturbance at both sites, but this relationship differed between sites; for any given level of disturbance, incubating birds at the more disturbed site had greater nest attentiveness. They achieved this through habituation, allowing a closer human approach before leaving the nest, and returning to the nest faster after a disturbance event. Despite lower average daytime nest attentiveness at the more disturbed site, incubation temperatures did not differ significantly between sites. Nest mortality, mostly by natural mammalian and corvid predators, was significantly lower at the site experiencing high recreational activity. However, chick mortality was significantly greater at the more disturbed site, most likely because of predation by domestic dogs. Chick mortality may have been increased by the habituation of chicks, whose escape responses were much reduced at the more disturbed site. Nonetheless, annual fecundity was substantially higher at the more disturbed site, showing that the overall reproductive fitness of wild birds is not always compromised by human disturbance and urbanization.

López-Suárez, P., Varo-Cruz, N., Hazevoet, C. J., and López-Jurado, L. F. **Restricted nesting habitat and reproductive failure of Magnificent Frigatebirds *Fregata magnificens* in the Cape Verde Islands.** *Atlantic Seabirds* 7(3): 107-120, 2005 [PUBLISHED August 2007].

Notes: The islets of Baluarte and Currel Velho, off the island of Boavista, Cape Verde Islands, are the only two breeding sites of the Magnificent Frigatebird *Fregata magnificens* in the Western Palaearctic. This East Atlantic relict population was monitored from the summer of 1999 up to May 2006. Most surveys were conducted during the breeding season, i.e. from November to June. Total reproductive failure has been the rule over the last seven consecutive breeding seasons. Possible causes of nest failure are attributed to: 1) accidental egg loss during the incubation period; 2) hatching failure. The most plausible reasons explaining both causes are discussed. Human persecution and disturbance, restricted nesting habitat and isolation, and unsuccessful breeding has brought the population on the verge of extinction. The remaining population, thought to consist of 4-5 adult individuals (2 females and 2-3 males), is unlikely to survive on its own.

O'Hara, P.D. and Morgan, K.H. **Do low rates of oiled carcass recovery in beached bird surveys indicate low rates of ship-source oil spills?** *Marine Ornithology* 34(2): 133-140, 2006 [PUBLISHED July 2007].

Notes: Oil pollution is a serious threat to marine ecosystems. Beached bird surveys, which are networks of volunteers who survey beaches for seabird carcasses, are conducted worldwide. Data from these surveys have played a major role in determining that chronically occurring small-scale oil pollution can have cumulative ecosystem-level impacts. Within Canada, Newfoundland and Labrador has reported high rates of oiled carcasses in beached bird surveys (62%), whereas oiled carcass densities in British Columbia are low (12%) compared with Newfoundland and Labrador and other parts of the world. Here, we present a "risk model" as an approach to interpreting beached bird survey data. The model incorporates spatiotemporal distributions of seabirds that are considered vulnerable to oil pollution, shipping densities as a proxy for risk of oil spills, and the proximity of both to areas where beached bird surveys are conducted. Using the model, we identify BC surveys along the west coast of Vancouver Island as most similar to surveys conducted in Newfoundland and Labrador, and we note that 56% of carcasses reported in the BC surveys were oiled, a rate that is similar to rates found in the Newfoundland and Labrador surveys. Finally, we emphasize that wind (speed, direction and persistence) and the location of beach surveys (relative to seabird distributions and high-traffic shipping lanes) must be considered when interpreting beached bird survey results. Because wind data are archived and publicly available, they can be used in reanalyzing older beached bird data from British Columbia. Wind data would also be useful for coordinating future survey efforts, leading to better documentation of the oiling rates of birds off the coast of British Columbia. Finally, our model provides a framework for estimating the risk to seabirds of oiling at sea and for identifying information gaps.

Newton, I. **Weather-related mass-mortality events in migrants.** *Ibis* 149(3): 453-467, 2007.

Notes: A major perceived cost of migration in birds is the associated mortality. This mortality has proved difficult to measure and separate from mortality during stationary periods of the annual cycle. This paper reviews some major recorded mortality incidents among migratory birds attributed to inclement weather and other factors, including: (1) in-flight losses, caused by storms and other adverse weather en route, usually over water; (2) unseasonable cold weather soon after arrival in breeding areas; and (3) unseasonable cold weather before departure from breeding areas. Cold weather often kills migrants in their breeding areas, but not the local resident species which can better withstand it at those times. For migrants, cold and snow act to cut off the food supply, and can have a major selective effect on the seasonal timing of migration. Records of in-flight weather-induced mortality, involving up to hundreds or thousands of birds at a time, have affected mainly small passerines, but also larger birds, including eagles and swans. Most occurred in conditions of mist, rain or snow storms, and some involved nocturnal collisions with illuminated masts and other tall structures. Records of post-arrival mortality in breeding areas have involved mainly small insectivores (especially hirundines), but also waders and waterfowl. Such incidents, associated with cold and snow, have reduced local breeding densities from the previous year by 25-90%, depending on species and area, with up to several years required for recovery. Records of pre-departure mortality on breeding areas have mainly affected hirundines. Two major incidents in central Europe in September 1931 and 1974 killed hundreds of thousands, or even millions, of swallows and martins. After the latter incident, House Martin *Delichon urbicum* populations in Switzerland the following year were reduced by an estimated 25-30%. Such climatic extremes that occurred in spring or late summer in particular parts of the breeding range have been recorded at approximate mean frequencies of 2-10 per century. Average daily mortality in many bird species can clearly be much greater during migration periods than during stationary periods. Despite the heavy losses of birds on migration, it may be assumed that migration persists in the long term because the fitness costs (in terms of associated mortality) are more than offset by the fitness benefits (in terms of improved overall survival and breeding success) that accrue from migration.

Alonso-Alvarez, C., Munilla, I., Lopez-Alonso, M., and Velando, A. **Sublethal toxicity of the Prestige oil spill on yellow-legged gulls.** *Environment International* 33(6): 773-781, 2007.

Notes: The Prestige oil spill in November 2002 is considered the biggest large-scale catastrophe of its type in Europe, thousands of seabirds dying in the subsequent months. Here, the total concentration of 16 polycyclic aromatic hydrocarbons (TPAH) was measured in the blood cell fraction of adult and chick yellow-legged gulls (*Larus michabellis*) from unoiled and oiled coastal areas in North Western Spain. In addition, hematocrit, plasma metabolites, electrolytes and enzymes, as well as body mass were determined in the same individuals. Our results strongly suggest the presence of health damages of sublethal nature in adult gulls breeding in oiled colonies 17 months after the Prestige oil spill. This is supported by the following

evidences: (1) gulls sampled in unoiled and oiled colonies differed in blood TPAH levels, (2) gulls sampled in unoiled and oiled colonies differed in several blood parameters indicative of physiological disorders, and (3) TPAH in blood was significantly related to several of these parameters. Differences in the level of aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), total protein, glucose and inorganic phosphorus suggest damages on some vital organs (i.e. liver and kidney) in adult birds from oiled areas. Meanwhile, chicks presented weaker effects than adults, showing only between-area differences in hematocrit. Since TPAH levels in blood did not differ between both age-groups, the stronger effects on adults should be due to their longer exposure to these pollutants and/or to severe exposure in the months following the spill. The presence of PAHs in chicks indicates that these pollutants were incorporated into the food chain because nestlings would have been only exposed to contaminated organisms in the diet (e.g. fishes and crustaceans). Our findings support the view that PAHs may deeply alter the physiology of seabirds, and emphasize the necessity of quantifying the circulating levels of these compounds in order to evaluate the sublethal effects associated to large oil spills.

Braune, B.A. **Temporal trends of organochlorines and mercury in seabird eggs from the Canadian Arctic, 1975-2003.** *Environmental Pollution* 148(2): 599-613, 2007.

Notes: Organochlorine pesticides, PCBs, total mercury and selenium were measured in eggs of thick-billed murres, northern fulmars and black-legged kittiwakes collected from Prince Leopold Island in the Canadian High Arctic between 1975 and 2003. The primary organochlorines found were Σ PCB, *p,p'*-DDE, oxychlorane, and hexachlorobenzene (HCB). Most of organochlorines analyzed showed either significant declines or no significant change between 1975 and 2003 in all three species. However, significant increases were observed for Σ HCH in the kittiwakes and fulmars, and β -HCH in the murres and fulmars. Mercury increased significantly in eggs of murres and fulmars, whereas mercury in the kittiwakes did not change significantly over the study period. Statistical analyses included stable-nitrogen isotope ratios ($\delta^{15}\text{N}$) to control for any variation in trophic level over time. Although the contaminant concentrations reported in this study are below published threshold values, mercury and β -HCH concentrations continue to increase suggesting that continued monitoring is warranted.

Albers, P.H. **Birds and polycyclic aromatic hydrocarbons.** *Avian and Poultry Biology Reviews* 17(4): 125-140, 2006.

Notes: Polycyclic aromatic hydrocarbons (PAH) are present throughout the global environment and are produced naturally and by activities of humans. Effects of PAH on birds have been determined by studies employing egg injection, egg immersion, egg shell application, single and multiple oral doses, subcutaneous injection, and chemical analysis of field-collected eggs and tissue. The four-to six-ring aromatic compounds are the most toxic to embryos, young birds, and adult birds. For embryos, effects include death, developmental abnormalities, and a variety of cellular and biochemical responses. For adult and young birds, effects include reduced egg production and hatching, increased clutch or brood abandonment, reduced growth, increased organ weights, and a variety of biochemical responses. Trophic level accumulation is unlikely. Environmental exposure to PAH in areas of high human population or habitats affected by recent petroleum spills might be sufficient to adversely affect reproduction. Evidence of long-term effects of elevated concentrations of environmental PAH on bird populations is very limited and the mechanisms of effect are unclear.

O'Hara, P.D., Haase, B.J.M., Elnor, R.W., Smith, B.D., and Kenyon, J.K. **Are population dynamics of shorebirds affected by El Niño/Southern Oscillation (ENSO) while on their non-breeding grounds in Ecuador?** *Estuarine, Coastal and Shelf Science* 74(1-2): 96-108, 2007.

Notes: Declines in avian populations are a global concern, particularly for species that migrate between Arctic-temperate and tropical locations. Long-term population studies offer opportunities to detect and document ecological effects attributable to long-term climatic cycles such as the El Niño/Southern Oscillation (ENSO). In this study, we report possible population-level effects of such climatic cycles on shorebird species that use two non-breeding season sites in Ecuador (Santa Elena peninsula area, near La Libertad). During our 9-year study period (1991/1992-1999/2000), there was a particularly strong ENSO warm phase event during 1997/1998. Population trend data for three species of shorebird, Western Sandpipers (*Calidris mauri*), Sernipalmated Sandpipers (*C. pusilla*), and Least Sandpipers (*C. minutilla*), indicated abundances generally declined during the 1990s, but there was an increase in the proportion of first-year birds and their abundance in the years following the 1997/1998 ENSO warm phase. There was some support for variation in apparent survivorship associated with the onset of the ENSO

warm phase event in our population models, based on capture-mark-recapture data. Following the 1997/1998 ENSO event onset, individuals for all three species were significantly lighter during the non-breeding season ($F_{1,3789} = 6.6, p = 0.01$). Least-squares mean mass (controlling for size, sex, and day of capture) for first-year birds dropped significantly more than for adults following ENSO (first-year mass loss = 0.69 ± 0.12 g; adult mass loss = 0.34 ± 0.11 g, $F_{1,3789} = 5.31, p = 0.021$), and least-squares mean mass dropped most during the period when sandpipers prepare for northward migration by gaining mass and moulting into breeding plumage. Least Sandpipers may have declined the most in mean mass following ENSO (0.76 ± 0.19 g), whereas Semipalmated Sandpipers were 0.52 ± 0.12 g lighter, and Western Sandpipers 0.40 ± 0.13 g lighter, but overall variation among species before (1992/1993-1996/1997) and after (1997/1998-1999/2000) ENSO was not significant ($F_{2,3787} = 1.52, p = 0.22$). Anomalously warm and wet conditions associated with strong ENSO warm phases during the non-breeding season may either act directly on shorebirds (increasing metabolic demands) and/or indirectly through reductions in prey availability. Reduced mass and mass gain may explain lower survivorship, particularly in adults, which are more likely to migrate northward in the spring than are first-year birds, at least in Western Sandpipers. Our results suggest a potential mechanism selecting for life history strategies suitable for withstanding long-term fluctuating climatic cycles such as ENSO.

Haramis, G.M., Link, W.A., Osenton, P.C., Carter, D.B., Weber, R.G., Clark, N.A., Teece, M.A., and Mizrahi, D.S. **Stable isotope and pen feeding trial studies confirm the value of horseshoe crab *Limulus polyphemus* eggs to spring migrant shorebirds in Delaware Bay.** *Journal of Avian Biology* 38(3): 367-376, 2007.

Notes: We used stable isotope (SI) methods in combination with pen feeding trials to determine the importance of eggs of the Atlantic horseshoe crab *Limulus polyphemus* to migratory fattening of red knots *Calidris canutus rufa* and ruddy turnstones *Arenaria interpres morinella* during spring stopover in Delaware Bay. By manifesting measurable fractionation (ca + 3 parts per thousand) and rapid turnover, blood plasma $\delta^{15}\text{N}$ nitrogen proved a functional marker for SI diet tracking during the short 3-week stopover. Blood samples from free-ranging knots (3 data sets) and turnstones (1 data set) produced similar convergence of plasma $\delta^{15}\text{N}$ signatures with increasing body mass that indicated highly similar diets. Asymptotes deviated slightly (0.3 parts per thousand to 0.7 parts per thousand) from that of captive shorebirds fed a diet of only crab eggs during stopover, thus confirming a strong crab egg-shorebird linkage. The plasma $\delta^{15}\text{N}$ crab-egg diet asymptote was enriched ca +4.5 parts per thousand and therefore readily discriminated from that of either blue mussels *Mytilus edulis* or coquina clams *Donax variabilis*, the most likely alternative prey of knots in Delaware Bay. Crab eggs were highly palatable to captive knots and turnstones which achieved rates of mass gain (3-11 g/d) comparable to that of free-ranging birds. Peak consumption rates during hyperphagic events were 23,940 and 19,360 eggs/bird/d, respectively. The empirical conversions of eggs consumed to body mass gained (5,017 eggs/g for knots and 4,320 eggs/g for turnstones) indicate the large quantities of crab eggs required for the maintenance of these shorebird populations during stopover.

Morrison, R.I.G., Davidson, N.C., and Wilson, J.R. **Survival of the fittest: body stores on migration and survival in red knots *Calidris canutus islandica*.** *Journal of Avian Biology* 38(4): 479-487, 2007.

Notes: Severe summer weather in Greenland and Arctic Canada in 1972 and 1974 caused very poor breeding success and elevated adult mortality in red knots *Calidris canutus islandica*. We show that those individual knots that are known to have survived these summers were in better than average nutritional condition shortly before departure from their late spring staging area in west Iceland. The condition index of previously banded or subsequently recovered birds captured in Iceland was positively related to the number of summers they were known to have survived. Body stores carried from the last spring staging area to the breeding grounds appear to offer Arctic-breeding shorebirds significant selective advantages: they are used for physical transformation from migration to breeding condition, and in years when weather is difficult may enable survival after arrival on the breeding grounds.

Braune, B.M., Mallory, M.L., Gilchrist, H.G., Letcher, R.J., and Drouillard, K.G. **Levels and trends of organochlorines and brominated flame retardants in Ivory Gull eggs from the Canadian Arctic, 1976 to 2004.** *The Science of the Total Environment* 378(3): 403-417, 2007.

Notes: The ivory gull (*Pagophila eburnea*) is a circumpolar marine bird which has recently been listed as an endangered species in Canada. To determine whether contaminants may be playing a role in the population decline of this species, ivory gull eggs

collected in 1976, 1987 and 2004 from Seymour Island in the Canadian Arctic were analyzed for organochlorines, polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and non-ortho PCBs. This study also provides the first account of polybrominated diphenyl ethers (PBDEs), hexabromocyclodo-decanes (HBCDs) and polybrominated biphenyls (PBBs) in ivory gulls. The most quantitatively abundant legacy organochlorines found in the ivory gull eggs were *p,p'*-DDE, Σ PCB and oxychlorane. Concentrations of the organochlorines analyzed either decreased or showed little change between 1976 and 2004. Concentrations of Σ PCDD in ivory gull eggs were greater than Σ PCDF, and the non-ortho PCBs (primarily PCB-126) contributed the largest fraction to the total TEQ value in all years sampled. Concentrations of PCDDs, PCDFs and Σ TEQ decreased from 1976 to 2004. In contrast, concentrations of the PBDEs steadily increased between 1976 and 2004 driven primarily by increases in BDE-47. Although concentrations of the persistent chlorinated compounds (i.e. organochlorine pesticides, PCBs, PCDDs, PCDFs) reported in this study were below published toxicological threshold values for eggs of wild birds, we cannot rule out the possibility of synergistic/additive, sublethal effects. Very few studies have been carried out to evaluate the exposure-effect relationship of the persistent brominated compounds in avian species. Given the scarcity of information on toxicity threshold levels for PBBs and PBDEs in avian species, coupled with the trend toward increasing concentrations in ivory gulls, continued monitoring and further toxicological studies of these compounds are warranted.

Harris, M.L., Wilson, L.K., Trudeau, S.F., and Elliott, J.E. **Vitamin A and contaminant concentrations in surf scoters (*Melanitta perspicillata*) wintering on the Pacific coast of British Columbia, Canada.** *The Science of the Total Environment* 378(3): 366-375, 2007.

Notes: Surf scoters are part of a community of sea ducks on the western coast of North America that have shown signs of long-term, unexplained declines in breeding bird numbers. Substantial numbers of scoters winter in the major harbours on the west coast, after breeding in the west-central northern boreal forest. To address the potential for contaminants to impact the health and survival of those birds, we investigated the condition and contamination of surf scoters during the winters of 1998-2001 at four foraging locations in the Strait of Georgia region of the Pacific coast of Canada. Vitamin A status was evaluated in liver and plasma samples collected from adults and juveniles, as part of a larger assessment of tissue contamination, body condition and biomarker responses. Individuals collected from a relatively contaminated site, Howe Sound, showed consistently low hepatic concentrations of retinol and retinyl palmitate forms of vitamin A, and gender-specific associations of retinyl palmitate with hepatic EROD activity. The relationship of hepatic retinol to retinyl palmitate was not constant across geographic locations, and a clear, linear relationship between the two forms of vitamin A was only evident in birds from the relatively uncontaminated site. This study also identified strong positive relationships between vitamin A and tissue burdens of cadmium and zinc. The positive association between hepatic retinyl palmitate and renal cadmium is similar to one observed in laboratory rats, in which a mechanism of interference with the controlled release of retinol from the liver was suggested.

Crawford, R.J.M., Dundee, B.L., Dyer, B.M., Klages, N.T.W., Meyer, M.A., and Upfold, L. **Trends in numbers of Cape gannets (*Morus capensis*), 1956/1957-2005/2006, with a consideration of the influence of food and other factors.** *ICES Journal of Marine Science* 64(1): 169-177, 2007.

Notes: Cape gannets (*Morus capensis*) breed at six colonies in Namibia and South Africa. Population size averaged about 250 000 pairs over the period 1956/1957-1968/1969 and about 150 000 pairs from 1978/1979 to 2005/2006. Over the whole 50-y period, numbers at the three Namibian colonies fell by 85-98%, with greater proportional decreases in the south. There were increases at two South African colonies between 1956/1957 and 2005/2006. The colony at Lambert's Bay increased between 1956/1957 and 2003/2004, but attacks by Cape fur seals (*Arctocephalus pusillus*) on birds at nests caused abandonment of the entire colony in 2005/2006. Longterm changes at colonies are thought to be largely attributable to an altered abundance and distribution of prey, especially sardine (*Sardinops sagax*) and anchovy (*Engraulis encrasicolus*). In both Namibia and South Africa, the numbers of Cape gannets breeding were significantly related to the biomass of epipelagic fish prey. Over the 50-y period, there was also a marked similarity in the proportions of gannets and epipelagic fish in the Benguela system, which were present in Namibia and South Africa. In the 2000s, there was an eastward shift in the distribution of sardine off South Africa and a large increase in the number of gannets breeding at South Africa's easternmost colony. When sardine were scarce off South Africa, gannets fed on anchovy, but off Namibia anchovy only temporarily and partially replaced sardine. Ecosystem management measures that might improve the conservation status of Cape gannets are considered.

Crawford, R.J.M., Underhill, L.G., Upfold, L., and Dyer, B.M. **An altered carrying capacity of the Benguela upwelling ecosystem for African penguins (*Spheniscus demersus*).** *ICES Journal of Marine Science* 64(3): 570-576, 2007.

Notes: The carrying capacity of an ecosystem for a species is an input parameter that is required for some models that assess population viability. It may be changed by an altered structure or functioning of the ecosystem, e.g. as a consequence of changes brought about by fishing or environmental change. Hence, it cannot necessarily be assumed that the pristine level of abundance of a species reflects the present-day carrying capacity of the ecosystem for that species. Historical and modern information on abundance and density-dependent responses is used to investigate changes in the carrying capacity of the Benguela upwelling ecosystem for African penguins (*Spheniscus demersus*), a species categorized as vulnerable. The carrying capacity was estimated to decrease from 1.5-3.0 million adult birds in the 1920s to just 10-20% of this value from 1978 to 2006, as a result inter alia of increased competition for food with purse-seine fisheries and fur seals (*Arctocephalus pusillus pusillus*). From 1988/1989 to 2005/2006, the per capita recruitment of young penguins to a colony where nesting space was not limiting was inversely related to the size of that colony, suggestive of a density-dependent response perhaps related to food availability.

Larsen, J.K. and Guillemette, M. **Effects of wind turbines on flight behaviour of wintering common eiders: implications for habitat use and collision risk.** *Journal of Applied Ecology* 44(3): 516-522, 2007.

Notes: 1. Wind energy is a fast-growing renewable energy source and many offshore wind parks will be erected in shallow waters (< 40 m deep) where various coastal bird species are found. The two main issues regarding offshore wind farms and birds are disturbance and collision risk. We studied the effect of wind turbines on the flight behaviour of wintering common eiders *Somateria mollissima* in order to identify the properties that cause disturbance and the factors that may increase their risk of collision. 2. The study was conducted at Tuno Knob offshore wind park in the Kattegat, Denmark. We attracted birds through the use of decoys located at increasing distances from the wind park. To discriminate between the potential disturbance effect of the standing towers from that of the revolving rotor blades, wind turbines were switched on or off alternately during 10 experimental trials. 3. Common eiders reacted strongly to the presence of wind turbines. The number of flying birds was significantly related to flight corridor location and position of the decoy group. That behavioural reaction was interpreted to be a consequence of their high speed and low-maneuvrability flight occurring within the vertical height range of the wind turbines. The number of landing birds also reacted to the position of the decoy group in relation to proximity to the turbines, with the greatest effects observed within the wind park. Such avoidance behaviour might decrease use of otherwise suitable habitat. 4. The movement and noise of rotors affected neither the number of common eiders flying within corridors nor the number of birds reacting to decoys. This suggests that the avoidance behaviour observed was caused by the presence of the structures themselves and that eiders use vision when avoiding human-made structures. 5. *Synthesis and applications.* This study has demonstrated that common eiders avoid flying close to or into the Tuno Knob wind park. This behaviour may result in a reduction in habitat availability within and around wind parks, and raises concerns about the possible impact of the extensive development of large-scale wind parks in shallow offshore waters, which are the main feeding areas for sea ducks and other marine birds. Our results indicate that the disturbance effect of revolving rotor blades is negligible during daylight hours but highlights the need for studies to be carried out during hours of darkness and conditions of poor visibility (e.g. fog and snow). Until more insight is gained, we recommend caution when planning wind parks in areas of high sea duck densities.

Norris, D.R., Arcese, P., Preikshot, D., Bertram, D.F., and Kyser, T.K. **Diet reconstruction and historic population dynamics in a threatened seabird.** *Journal of Applied Ecology* 44(4): 875-884, 2007.

Notes: 1. For the overwhelming majority of species, we lack long-term information on the dynamics of populations. As a consequence, we face considerable uncertainty about how to discriminate among competing hypotheses of population decline and design conservation plans. 2. The marbled murrelet *Brachyramphus marmoratus* is a small seabird that nests in coastal old-growth forest but feeds year-round in near-shore waters of the north-eastern Pacific. Although a decline in nesting habitat is the primary reason why marbled murrelets are listed as threatened in Canada, nest predation and food availability may also influence population abundance. To examine the hypothesis that murrelet populations are influenced by variation in diet quality, we analysed stable-carbon and -nitrogen isotopes in feathers of museum specimens collected in the Georgia Basin, British Columbia. 3. Between 1889 and 1996, we found a decline in stable isotopic signatures that was approximately equal to a

62% drop in trophic feeding level. We also found that the estimated proportion of fish in murrelet diet was related closely to murrelet abundance over the past 40 years, as estimated from volunteer surveys. Using these isotopic data, we modelled population size as a function of variation in reproductive rate due to changes in diet quality and found that our model matched closely the 40-year field estimates. We then applied our 107-year isotopic record to the model to back-cast estimates of population growth rate to 1889. 4. Our results suggest that, up to the 1950s, murrelet populations in the Georgia Basin were capable of growing and were probably limited by factors other than diet quality. After this period, however, our results imply that murrelets were often, but not solely, limited by diet quality. 5. *Synthesis and applications.* Protecting nesting habitat may not be sufficient to rebuild populations of this highly secretive and threatened seabird and recovery might also require the restoration of marine habitat quality, as well as a better understanding of how ocean climate affects prey abundance and reproductive rate. Combined with contemporary demographic data, stable isotope analysis of historic samples provides a unique opportunity to reconstruct population histories for species where we lack long-term information.

Atkinson, P.W., Baker, A.J., Bennett, K.A., Clark, N.A., Clark, J.A., Cole, K.B., Dekinga, A., Dey, A., Gillings, S., Gonzalez, P.M., Kalasz, K., Minton, C.D.T., Newton, J., Niles, L.J., Piersma, T., Robinson, R.A., and Sitters, H.P. **Rates of mass gain and energy deposition in red knot on their final spring staging site is both time- and condition-dependent.** *Journal of Applied Ecology* 44(4): 885-895, 2007.

Notes: 1. Millions of shorebirds migrate each year through a small number of highly productive staging areas where they often conflict with fisheries interests. Delaware Bay, USA, is a major shorebird stopover site where, in spring, many thousands of shorebirds undergo rapid mass gain by feeding on the eggs of commercially harvested horseshoe crabs *Limulus polyphemus*. 2. Environmental factors may cause deviations from the best migration schedule. We used within-year mass gain data from red knot *Calidris canutus* caught in Delaware Bay between 1998 and 2005 to determine the degree of flexibility individuals have to vary migration speed. 3. Mass gain by birds below 133 g was shown to comprise 15.3% fat (39 kJ g⁻¹), the remainder being lean mass (6 kJ g⁻¹). Above this critical level, fat comprised 83.9% of mass deposition. The rates of energy deposition (kJ d⁻¹) were therefore fundamentally different between the two states but were among the highest ever recorded among vertebrates (5-7 x basic metabolic rate). 4. A total of 36-62% of the variation in observed rates of energy deposition between 1998 and 2002 was explained by a year factor, date and mass at initial capture and interaction terms, such that light-weight birds at the end of May had rates of mass gain or energy deposition two to three times higher than birds of similar mass in mid-May, indicating that birds were attempting to achieve a certain mass by a certain date. In 2003 and 2005, this relationship broke down as a result of lower densities of eggs. 5. *Synthesis and application.* The maintenance of high densities of crab eggs required for high rates of mass gain in red knot requires severe cuts in, or the complete cessation of, the crab harvest, reduced human and raptor-related disturbance as well as management of beaches to provide sufficient crab-spawning habitat. These findings are widely applicable to other systems where harvesting activities come into conflict with migrating animals and show that certain sections of the population, in this case the long-distance migrants from South America, will be impacted more than short-distance migrants whose physiology may give them access to alternative food resources.

Vargas, F.H., Lacy, R.C., Johnson, P.J., Steinfurth, A., Crawford, R.J.M., Boersma, P.D., and Macdonald, D.W. **Modelling the effect of El Nino on the persistence of small populations: The Galapagos penguin as a case study.** *Biological Conservation* 137(1): 138-148, 2007.

Notes: Small populations are vulnerable to long-term declines, even where short-term censuses indicate increasing trends in numbers. Census data for the Galapagos penguin (*Spheniscus mendiculus*) collected between 1970 and 2004 provide evidence that despite year-to-year population increases detected in most of the annual censuses, the strong El Nino events of 1982-83 and 1997-98 were followed by population declines of more than 60% from which the species has yet to recover. Such large declines raise concerns about the future viability of the species because the frequency and severity of El Nino events are predicted to increase. We used the simulation software VORTEX to evaluate the potential effects of El Nino on the risk of extinction of the Galapagos penguin population and its four constituent subpopulations. Weak and strong El Nino events were treated as catastrophes, with varying frequencies, which simulated past, current and future effects on the penguin population. The "Current El Nino" scenario, based on the frequency of El Nino events recorded in the Galapagos between 1965 and 2004, indicated an approximately 30% probability of extinction within the next 100 years for the penguin population. More ominously, the species may be at a greater risk if the frequency of strong El Nino episodes increases only marginally. A probability of extinction greater than 80% was predicted when the current frequency (5%) of strong El Nino events was doubled (to 10%). The probabilities of extinctions were higher for each subpopulation treated individually, ranging from 34%

for Isabela and Fernandina, 64% for Bartolome-Santiago to 78% for the smallest subpopulation on Floreana. Sensitivity analyses identified survival of penguins during El Nino events and sex ratio as influential parameters. The estimates of extinction risk may be conservative as other threats associated with increased human activities on the islands may further compromise species persistence.

Baker, G.B., Double, M.C., Gales, R., Tuck, G.N., Abbott, C.L., Ryan, P.G., Petersen, S.L., Robertson, C.J.R., and Alderman, R. **A global assessment of the impact of fisheries-related mortality on shy and white-capped albatrosses: Conservation implications.** *Biological Conservation* 137(3): 319-333, 2007.

Notes: Hundreds of thousands of seabirds are killed each year as a result of interacting with longline and trawl fishing operations, and the severity of the impact varies regionally. Shy and white-capped albatrosses, *Thalassarche cauta* and *Thalassarche steadi* respectively, are phenotypically similar species known to be incidentally killed by fishing operations. The magnitude of this mortality has not previously been assessed across their range. Here we examine recent effort and bycatch rates in fisheries known to incidentally kill these species and qualitatively evaluate the level of impact of each fishery. Results indicate that over 8500 of these albatrosses may be killed annually, although the reliability of this estimate is low due to the paucity of comprehensive observer data in most fisheries. Of the estimated deaths of all seabird species in the fisheries assessed, trawl and longline fisheries killed birds in approximately equal proportions, but when the mortality levels of shy-type albatrosses were examined, trawl fisheries were responsible for 75% of all deaths. Data suggest most of these birds were killed in South African, Namibian and New Zealand demersal trawl fisheries and the South Africa pelagic longline fishery. Because most adult shy albatrosses are comparatively sedentary and rarely found outside Australian waters, it is primarily juvenile shy albatrosses that regularly encounter fishing fleets known to kill large numbers of albatrosses. In contrast, throughout most of their range juvenile and adult white-capped albatrosses are exposed to fisheries that collectively kill many thousands of these albatrosses each year. These data emphasise the urgent need for robust assessments of the impact of bycatch at a species and population level, and the urgent implementation of effective mitigation measures.

Suryan, R.M., Dietrich, K.S., Melvin, E.F., Balogh, G.R., Sato, F., and Ozaki, K. **Migratory routes of short-tailed albatrosses: Use of exclusive economic zones of North Pacific Rim countries and spatial overlap with commercial fisheries in Alaska.** *Biological Conservation* 137(3): 450-460, 2007.

Notes: We conducted a satellite tracking study of the endangered short-tailed albatross (*Phoebastria albatrus*) to determine post-breeding season distribution, the amount of time spent within exclusive economic zones of Pacific Rim countries, and assess factors affecting spatial and temporal overlap with commercial fisheries in Alaska. We obtained 6709 locations for 14 albatrosses (131-808 locations and 51-138 days of tracking per bird). Albatrosses ranged widely throughout the North Pacific Rim, spending the majority of time within the exclusive economic zones of Japan, Russia (Kuril Islands and Kamchatka Peninsula), and the United States (Aleutian Islands and Bering Sea, Alaska). We found evidence for gender and age-related differences in distribution and, therefore, potential interaction with regional fisheries. Overall, albatrosses spent the greatest proportion of time within the Alaska exclusive economic zone. Within Alaska, albatrosses occurred most frequently in fishery management zones that encompassed the Aleutian Islands, Bering Sea, and south of the Alaska Peninsula. Short-tailed albatrosses had the greatest potential overlap with fisheries that occurred along continental shelf break and slope regions, e.g., longlining for sablefish (*Anoplopoma fimbria*), where albatrosses occurred most often. Some birds, however, also made frequent excursions onto the extensive Bering Sea shelf, suggesting significant potential for interactions with the large-scale walleye pollock (*Theragra chalcogramma*) and Pacific cod (*Gadus macrocephalus*) fisheries. Alaskan longline fishing fleets have been proactive in using seabird deterrent devices, however, our data further emphasize that such efforts beyond the Alaska exclusive economic zone would provide a greater conservation benefit for this species.

Munilla, I., Diez, C., and Velando, A. **Are edge bird populations doomed to extinction? A retrospective analysis of the common guillemot collapse in Iberia.** *Biological Conservation* 137(3): 359-371, 2007.

Notes: In the first half of the XXth century, the common guillemot (*Uria aalge*) was the seabird with the largest breeding population in Atlantic Iberia (ca. 20,000 individuals), the low-latitude limit of the species breeding range. However, this population suffered a dramatic decline and is quasi-extinct at present. The decline was believed to be associated with reduced

availability of pelagic prey fish due to climate change. In this study, we analyzed the population change of Iberian guillemots in the second half of the XXth century by means of a retrospective analysis. Our study showed that between 1960 and 1974 the guillemots in Iberia suffered a dramatic population crash (33.3% annual decline) and that subsequently, the population continued to decline at a slower annual rate (13.4%). Simulation models indicated that the factors driving the population crash should be related to adult survival, rather than reproduction. The analysis of environmental and fishery data suggested good climate conditions and higher or sustained availability of pelagic prey fish when the Iberian guillemots crashed. In contrast, relevant human-related factors were affecting adult mortality in that period, specially a rapid and large increase in the number of synthetic fishing nets. During the collapse, no conservation measures were undertaken to mitigate anthropogenic threats and it was assumed, in some extent, that this low-latitude edge population was somehow prone to extinction as a consequence of climate change. This study highlights that to carelessly attribute the decline of rear edge populations to climate change could be highly misleading if the population is suffering from other, particularly human, threats.

Rayner, M.J., Clout, M.N., Stamp, R.K., Imber, M.J., Brunton, D.H., and Hauber, M.E. **Predictive habitat modelling for the population census of a burrowing seabird: A study of the endangered Cook's petrel.** *Biological Conservation* 138(1-2): 235-247, 2007.

Notes: Inaccurate population data remain a major problem in the conservation of burrow-nesting Procellariiform seabirds. We evaluated the potential of predictive habitat modelling, in contrast with traditional surface-area based strategies, to estimate the population size of the endangered Cook's petrel (*Pterodroma cookii*), breeding on one of two islands in New Zealand. Generalised linear models of burrow abundance using topographic data collected in the field, or extracted from Geographic Information System layers, were developed, and the final model applied to Geographic Information Systems-derived datasets in a population analysis. To compare this result with traditional census methods, population estimates were also calculated by averaging burrow densities across the total area available (simple model) and within vegetation zones (habitat-area model). Results of all models were scaled using rigorously collected burrow occupancy data. The final model, based upon altitude, slope, and distance from ridgelines, explained 31% of the variance in Cook's petrel burrow abundance and showed an enhanced predictive fit compared with the two area-based models. This model indicated that annually 286,000 (95% confidence interval: 213,000-413,000) pairs of Cook's petrel breed on Little Barrier Island, approximately six times that previously suggested. Population estimates based on simple and habitat-area models were less accurate, being 10% and 30% greater than the predictive model estimate, respectively. This study underlines the need for accurate population estimates for burrowing seabird taxa by presenting a major population revision for the Cook's petrel. Predictive habitat models, employing rigorously collected data, offer an improvement on more traditional population census methodologies that are susceptible to scale-induced bias.
