

### **In this review:**

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

**O/A denotes an open access article or journal**

### **A. Recent articles – no abstract**

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Keck, N., Kwiatek, O., Dhermain, F., Dupraz, F., Boulet, H., Danes, C., Laprie, C., Perrin, A., Godenir, J., Micout, L., and Libeau, G. **Resurgence of *Morbillivirus* infection in Mediterranean dolphins off the French coast.** *Veterinary Record* 166(21): 654-655, 2010.

Womble, J.N., Pendleton, G.W., Mathews, E.A., Blundell, G.M., Bool, N.M., and Gende, S.M. **Harbor seal (*Phoca vitulina richardi*) decline continues in the rapidly changing landscape of Glacier Bay National Park, Alaska 1992- 2008.** *Marine Mammal Science* 26(3): 686-697, 2010.

Kirkman, S.P. and Lavigne, D.M. **Assessing the hunting practices of Namibia's commercial seal hunt.** *South African Journal of Science* 106(3-4): 1-3, 2010. **O/A**

### **B. Recent articles with abstracts**

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Robards, M.D. and Lovcraft, A.L. **Evaluating comanagement for social-ecological fit: Indigenous priorities and agency mandates for Pacific walrus.** *Policy Studies Journal* 38(2): 257-279, 2010.

**Notes:** Governance arrangements such as comanagement are regarded by many as promising arenas for effective natural resource management. However, measuring comanagement's success at achieving conservation goals has been equivocal. Our research evaluates the lack of conclusive outcomes through a critical consideration of how different goals and values inherent in comanagement affect the institutional (or policy) diagnostic of "fit." More narrowly, sustaining natural resources requires that management policies foster fit between the scales of sociopolitical processes governing resource use and the scales of ecological processes regulating a resource. Without a process that encourages such harmonization, theoretical and empirical evidence suggests that comanagement regimes are unlikely to accomplish long-term conservation goals. We use a case study of walrus comanagement under the U.S. Marine Mammal Protection Act to demonstrate that when the formal institutions preconditioning comanagement do not develop out of a deliberative process among comanagement partners, two major problems can arise: (i) Policy institutions mismatch ecological and social processes relevant to resources and communities; and (ii) data to assess the fit of institutions and support learning is more difficult to acquire. In our case study, both these factors constrain the ability of comanagement to foster walrus conservation or support the capacity of Native Alaskans to adapt to contemporary social and environmental conditions. Our research concludes that to achieve marine mammal conservation, previous institutional arrangements framing comanagement that are predicated on static conceptions of people and ecosystems must be redesigned to provide better policy fit across local to international priorities. To do so requires opening up deliberative spaces, where Western science

and priorities are confronted with indigenous perspectives. However, the benefit of enhancing deliberation carries risks and costs related to trade-offs between the values of democratic process, and protections for both wildlife species and indigenous groups.

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Rugh, D.J., Shelden, K.E.W., and Hobbs, R.C. **Range contraction in a beluga whale population.** *Endangered Species Research* 12(1): 69-75, 2010. **O/A**

**Notes:** The small, isolated population of beluga whales *Delphinapterus leucas* in Cook Inlet, Alaska, USA, has had a distinct contraction in range over the past 3 decades. This contraction is a function of a decline in abundance, evidently caused, at least in part, by high takes during unregulated subsistence hunting. During the 1990s, hunting resulted in takes of over 50 whales yr<sup>-1</sup>, all of which occurred in the northern portion of Cook Inlet. Concurrent with the decline in abundance, sightings became rare in the southern inlet, even though human impact had been relatively low there. Curiously, the density of whales in the northern inlet remained high in spite of the hunts. Significant changes in beluga whale distribution are evident across 3 periods: 1978-1979 (the earliest well-documented data); 1993-1997 (during the recorded decline in abundance); and 1998-2008 (when hunting was regulated and recovery was anticipated). The center of the summer range of beluga whales contracted northeastward into upper Cook Inlet from the 1970s to the 1990s (38 km;  $p = 0.042$ ) and continued into the 2000s (total of 53 km;  $p = 0.022$ ) with a longitudinal shift east towards Anchorage (the largest city and port in Alaska) occurring between the 1990s and 2000s (17 km;  $p = 0.025$ ). The result is a reduced range (>7000 to <3000 km<sup>2</sup>) in all but the area with the highest degree of human disturbance. If and when the Cook Inlet beluga whale population begins to increase, a reoccupation of peripheral habitats may be the first indication of recovery.

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Heide-Jorgensen, M.P., Laidre, K.L., Borchers, D., Marques, T.A., Stern, H., and Simon, M. **The effect of sea-ice loss on beluga whales (*Delphinapterus leucas*) in West Greenland.** *Polar Research* 29(2): 198-208, 2010.

**Notes:** An aerial survey was conducted to estimate the abundance of belugas (*Delphinapterus leucas*) on their wintering ground in West Greenland in March-April 2006 and 2008. The survey was conducted as a double platform aerial line transect survey, and sampled approximately 17% of the total survey area of ca. 125 000 km<sup>2</sup>. The abundance of belugas was 10 595 (95% confidence interval 4904-24 650). The largest abundance was found at the northern part of Store Hellefiske Bank, at the eastern edge of the Baffin Bay pack ice, a pattern similar to that found in eight systematic surveys conducted since 1981. A clear relationship between decreasing sea-ice cover and increasing offshore distance of beluga sightings was established from all previous surveys, suggesting that belugas expand their distribution westward as new areas on the banks of West Greenland open up earlier in spring with reduced sea-ice coverage or early annual ice recession. This is in contrast to the relatively confined distribution of belugas near the coast in limited open areas in the early 1980s, when sea-ice cover was greater. However, the effects of the changes in coastal availability of belugas can also be observed with the correlation between catches from the local Inuit hunt and sea-ice cover, where the catches increased significantly with increasing sea-ice coverage during the period 1954-2006. These results, based on nearly 30 years of dedicated survey effort, are among the first available evidence showing a shift in distribution of an Arctic cetacean in response to changes in sea-ice coverage.

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Morin, P.A. et al. **Complete mitochondrial genome phylogeographic analysis of killer whales (*Orcinus orca*) indicates multiple species.** *Genome Research* 20(7): 908-916, 2010.

**Notes:** Killer whales (*Orcinus orca*) currently comprise a single, cosmopolitan species with a diverse diet. However, studies over the last 30 years have revealed populations of sympatric "ecotypes" with discrete prey preferences, morphology and behaviors. Although these ecotypes avoid social interactions and are not known to interbreed, genetic studies to date have found extremely low levels of diversity in the mitochondrial control region, and few clear phylogeographic patterns worldwide. This low level of diversity is likely due to low mitochondrial mutation rates that are common to cetaceans. Using killer whales as a case study, we have developed a method to readily sequence, assemble,

and analyze complete mitochondrial genomes from large numbers of samples to more accurately assess phylogeography and estimate divergence times. This represents an important tool for wildlife management, not only for killer whales but for many marine taxa. We used high-throughput sequencing to survey whole mitochondrial genome variation of 139 samples from the North Pacific, North Atlantic and southern oceans. Phylogenetic analysis indicated that each of the known ecotypes represents a strongly supported clade with divergence times ranging from approximately 150,000 to 700,000 years ago. We recommend that three named ecotypes be elevated to full species, and that the remaining types be recognized as subspecies pending additional data. Establishing appropriate taxonomic designations will greatly aid in understanding the ecological impacts and conservation needs of these important marine predators. We predict that phylogeographic mitogenomics will become an important tool for improved statistical phylogeography and more precise estimates of divergence times.

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Molnar, P.K., Derocher, A.E., Thiemann, G.W., and Lewis, M.A. **Predicting survival, reproduction and abundance of polar bears under climate change.** *Biological Conservation* 143(7): 1612-1622, 2010.

**Notes:** Polar bear (*Ursus maritimus*) populations are predicted to be negatively affected by climate warming, but the timeframe and manner in which change to polar bear populations will occur remains unclear. Predictions incorporating climate change effects are necessary for proactive population management, the setting of optimal harvest quotas, and conservation status decisions. Such predictions are difficult to obtain from historic data directly because past and predicted environmental conditions differ substantially. Here, we explore how models can be used to predict polar bear population responses under climate change. We suggest the development of mechanistic models aimed at predicting reproduction and survival as a function of the environment. Such models can often be developed, parameterized, and tested under current environmental conditions. Model predictions for reproduction and survival under future conditions could then be input into demographic projection models to improve abundance predictions under climate change. We illustrate the approach using two examples. First, using an individual-based dynamic energy budget model, we estimate that 3-6% of adult males in Western Hudson Bay would die of starvation before the end of a 120 day summer fasting period but 28-48% would die if climate warming increases the fasting period to 180 days. Expected changes in survival are non-linear (sigmoid) as a function of fasting period length. Second, we use an encounter rate model to predict changes in female mating probability under sea ice area declines and declines in mate-searching efficiency due to habitat fragmentation. The model predicts that mating success will decline non-linearly if searching efficiency declines faster than habitat area, and increase non-linearly otherwise. Specifically for the Lancaster Sound population, we predict that female mating success would decline from 99% to 91% if searching efficiency declined twice as fast as sea ice area, and to 72% if searching efficiency declined four times as fast as area. Sea ice is a complex and dynamic habitat that is rapidly changing. Failure to incorporate climate change effects into population projections can result in flawed conservation assessments and management decisions.

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Sonne, C. **Health effects from long-range transported contaminants in Arctic top predators: An integrated review based on studies of polar bears and relevant model species.** *Environment International* 36(5): 461-491, 2010.

**Notes:** The aim of this review is to provide a thorough overview of the health effects from the complexed biomagnified mixture of long-range transported industrial organochlorines (OCs), polybrominated diphenyl ethers (PBDEs), perfluorinated compounds (PFCs) and mercury (Hg) on polar bear (*Ursus maritimus*) health. Multiple scientific studies of polar bears indicate negative relationships between exposure to these contaminants and health parameters; however, these are all of a correlative nature and do not represent true cause-and-effects. Therefore, information from controlled studies of farmed Norwegian Arctic foxes (*Vulpes lagopus*) and housed East and West Greenland sledge dogs (*Canis familiaris*) were included as supportive weight of evidence in the clarification of contaminant exposure and health effects in polar bears. The review showed that hormone and vitamin concentrations, liver, kidney and thyroid gland morphology as well as reproductive and immune systems of polar bears are likely to be influenced by contaminant exposure. Furthermore, exclusively based on polar bear contaminant studies, bone density reduction and neurochemical disruption and DNA hypomethylation of the brain stem seemed to occur. The range of tissue concentration, at which these alterations were observed in polar bears, were ca. 1-70,000 ng/g lw for OCs (blood plasma concentrations of some PCB metabolites even higher), ca. 1-1000 ng/g lw for PBDEs and for PFCs and Hg 114-3052 ng/g ww and 0.1-50 µg/g

ww, respectively. Similar concentrations were found in farmed foxes and housed sledge dogs while the lack of dose response designs did not allow an estimation of threshold levels for oral exposure and accumulated tissue concentrations. Nor was it possible to pinpoint a specific group of contaminants being more important than others nor analyze their interactions. For East Greenland polar bears the corresponding daily  $\Sigma$ OC and  $\Sigma$ PBDE oral exposure was estimated to be 35 and 0.34  $\mu\text{g}/\text{kg}$  body weight, respectively. Furthermore, PFC concentrations, at which population effect levels could occur, are likely to be reached around year 2012 for the East Greenland polar bear subpopulation if current increasing temporal trends continue. Such proposed reproductive population effects were supported by physiological based pharmacokinetic (PBPK) modelling of critical body residues (CBR) with risk quotients  $\geq 1$  for  $\Sigma$ PCB, dieldrin,  $\Sigma$ PFC and  $\Sigma$ OHC (organohalogen contaminant). The estimated daily TEQ for East Greenland polar bears and East Greenland sledge dogs were 32-281-folds above WHO  $\Sigma$ TEQ guidelines for humans. Compared to human tolerable daily intake (TDI), these were exceeded for PCBs, dieldrin, chlordanes and  $\Sigma$ HCH in East Greenland polar bears. Comparisons like these should be done with caution, but together with the CBR modelling and T-score estimations, these were the only available tools for polar bear risk evaluation. In conclusion, polar bears seem to be susceptible to contaminant induced stress that may have an overall sub-clinical impact on their health and population status via impacts on their immune and reproductive systems.

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Gutleb, A.C., Ceniin, P., van Velzen, M., Lie, E., Ropstad, E., Skaare, J.U., Malmberg, T., Bergman, A., Gabrielsen, G.W., and Legler, J. **In vitro assay shows that PCB metabolites completely saturate thyroid hormone transport capacity in blood of wild polar bears (*Ursus maritimus*).** *Environmental Science and Technology* 44(8): 3149-3154, 2010.

**Notes:** Persistent chemicals accumulate in the arctic environment due to their chemical reactivity and physicochemical properties and polychlorinated biphenyls (PCBs) are the most concentrated pollutant class in polar bears (*Ursus maritimus*). Metabolism of PCB and polybrominated biphenyl ether (PBDE) flame-retardants alter their toxicological properties and these metabolites are known to interfere with the binding of thyroid hormone (TH) to transthyretin (TTR) in rodents and humans. In polar bear plasma samples no binding of [ $^{125}\text{I}$ ]- $\text{T}_4$  to TTR was observed after incubation and PAGE separation. Incubation of the plasma samples with [ $^{14}\text{C}$ ]-4-OH-CB107, a compound with a higher binding affinity to TTR than the endogenous ligand  $\text{T}_4$  resulted in competitive binding as proven by the appearance of a radio labeled TTR peak in the gel. Plasma incubation with  $\text{T}_4$  up to 1 mM, a concentration that is not physiologically relevant anymore did not result in any visible competition. These results give evidence that the binding sites on TTR for  $\text{T}_4$  in wild living polar bears are completely saturated. Such saturation of binding sites can explain observed lowered levels of THs and could lead to contaminant transport into the developing fetus.

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Tiedeken, J.A. and Ramsdell, J.S. **Zebrafish seizure model identifies *p,p'*-DDE as the dominant contaminant of fetal California sea lions that accounts for synergistic activity with domoic acid.** *Environmental Health Perspectives* 118(4): 545-551, 2010. **O/A**

**Notes:** BACKGROUND: Fetal poisoning of California sea lions (CSLs; *Zalophus californianus*) has been associated with exposure to the algal toxin domoic acid. These same sea lions accumulate a mixture of persistent environmental contaminants including pesticides and industrial products such as polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs). Developmental exposure to the pesticide dichlorodiphenyltrichloroethane (DDT) and its stable metabolite 1,1-bis-(4-chlorophenyl)-2,2-dichloroethene (*p,p'*-DDE) has been shown to enhance domoic acid induced seizures in zebrafish; however, the contribution of other co-occurring contaminants is unknown. OBJECTIVE: We formulated a mixture of contaminants to include PCBs, PBDEs, hexachlorocyclohexane (HCH), and chlordanes at levels matching those reported for fetal CSL blubber to determine the impact of co-occurring persistent contaminants with *p,p'*-DDE on chemically induced seizures in zebrafish as a model for the CSLs. METHODS: Embryos were exposed (6-30 hr postfertilization) to *p,p'*-DDE in the presence or absence of a defined contaminant mixture prior to neurodevelopment via either bath exposure or embryo yolk sac microinjection. After brain maturation (7 days postfertilization), fish were exposed to a chemical convulsant, either pentylenetetrazole or domoic acid; resulting seizure behavior was then monitored and analyzed for changes, using cameras and behavioral tracking software. RESULTS: Induced seizure behavior did not differ significantly between subjects with embryonic exposure to a contaminant

mixture and those exposed to **p,p'**-DDE only. CONCLUSION: These studies demonstrate that **p,p'**-DDE in the absence of PCBs, HCH, chlordane, and PBDEs that co-occur in fetal sea lions accounts for the synergistic activity that leads to greater sensitivity to domoic acid seizures.

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Nino-Torres, C.A., Zenteno-Savin, T., Gardner, S.C., and Urban, J. **Organochlorine pesticides and polychlorinated biphenyls in fin whales (*Balaenoptera physalus*) from the Gulf of California.** *Environmental Toxicology* 25(4): 381-390, 2010.

**Notes:** The present study reports unique data on concentrations of several classes of organochlorine pesticides and polychlorinated biphenyls in blubber biopsies from healthy living fin whales (***Balaenoptera physalus***) from the Gulf of California, Mexico, one of the most isolated and unstudied population in the world. OC levels in this population were generally lower than levels reported in fin whales from other regions. The rank order of OCs were  $\Sigma$ DDT's (range from 300 to 2400 ng g<sup>-1</sup> lw) >  $\Sigma$ PCBs (range from 40 to 290 ng g<sup>-1</sup> lw) >  $\Sigma$ HCHs (range from <LOQ to 92 ng g<sup>-1</sup> lw)  $\geq$   $\Sigma$ CHLORs (from < LOQ to 100 ng g<sup>-1</sup> lw) The most abundant OC pesticide measured was the DDT metabolite, **p,p'**-DDE. The PCBs 138, 153, and 180 were the most abundant PCBs congeners found in the fin whales samples. Males had significant higher concentrations of  $\Sigma$ OC,  $\Sigma$ DDT's and  $\Sigma$ PCBs than females (**P** < 0.05), although the **p,p'**-DDE/ $\Sigma$ DDT's ratios were similar between the sexes. Although the OC concentrations found in this population were generally below the levels that would be expected to cause deleterious health effects, the maximum values observed (2700 ng g<sup>-1</sup> lw) in some animals were higher than those associated with reproductive effects in whales. Given the small population size and highly isolated characteristics of Gulf of California fin whales, health effects in individuals could readily translate into population-level effects. Future research on this topic will be necessary to better understand the role that these compounds may have on the health of this population.

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Yordy, J.E., Pabst, D.A., McLellan, W.A., Wells, R.S., Rowles, T.K., and Kucklick, J.R. **Tissue-specific distribution and whole-body burden estimates of persistent organic pollutants in the bottlenose dolphin (*Tursiops truncatus*).** *Environmental Toxicology and Chemistry* 29(6): 1263-1273, 2010.

**Notes:** Most exposure assessments for free-ranging cetaceans focus on contaminant concentrations measured in blubber, and few data are available for other tissues or the factors governing contaminant distribution among tissues. The goal of this study was to provide a detailed description of the distribution of persistent organic pollutants (POPs) within the common bottlenose dolphin (***Tursiops truncatus***) body and assess the role of lipid dynamics in mediating contaminant distribution. Thirteen tissues (brain, blubber, heart, liver, lung, kidney, mammary gland, melon, skeletal muscle, spleen, thyroid, thymus, and testis/uterus) were sampled during necropsy from bottlenose dolphins (**n** = 4) and analyzed for lipid and 85 POPs, including polychlorinated biphenyls, organochlorine pesticides, and polybrominated diphenyl ethers. Significant correlations between tissue POP concentrations and lipid suggest that distribution of POPs is generally related to tissue lipid content. However, blubber:tissue partition coefficients ranged widely from 0.753 to 6.25, suggesting that contaminant distribution is not entirely lipid-dependent. Tissue-specific and whole-body contaminant burdens confirmed that blubber, the primary site of metabolic lipid storage, is also the primary site for POP accumulation, contributing >90% to the whole-body burdens. Observations also suggest that as lipid mobilizes from blubber, contaminants may redistribute, leading to elevated tissue concentrations. These results suggest that individuals with reduced blubber lipid may be at increased risk for exposure-related health effects. However, this study also provides evidence that the melon, a metabolically inert lipid-rich structure, may serve as an alternate depot for POPs, thus preventing the bulk of blubber contaminants from being directly available to other tissues. This unique physiological adaptation should be taken into consideration when assessing contaminant-related health effects in wild cetacean populations.

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Faerber, M.M. and Baird, R.W. Does a lack of observed beaked whale strandings in military exercise areas mean no impacts have occurred? A comparison of stranding and detection probabilities in the Canary and main Hawaiian Islands. *Marine Mammal Science* 26(3): 602-613, 2010.

**Notes:** Anthropogenic activities must be monitored to determine effects on marine mammal species, but the difficulty lies in how to measure impact. Mass strandings of beaked whales have occurred in association with naval exercises, with two species most affected, Cuvier's (*Ziphius cavirostris*) and Blainville's (*Mesoplodon densirostris*) beaked whales. Six such events have occurred in the Canary Islands but there have been no reported mass strandings in Hawai'i. We assess the hypothesis that factors that influence the likelihood of strandings occurring and/or being detected differ between the Canary and main Hawaiian Islands, such that beaked whale stranding/detection probabilities will be lower in Hawai'i. On an archipelago-wide basis, nearshore bathymetric comparisons indicate that the Canaries have a greater proportion and a total greater amount of appropriate beaked whale habitat closer to shore, with a steeper slope. Hawaiian shorelines are more dominated by steep cliffs, human population density is much lower, and human population per kilometer of shoreline is 53% lower than in the Canaries. All of these factors suggest that there is a higher probability of a carcass washing onshore and being detected in the Canary Islands. It cannot be concluded that the lack of mass strandings in Hawai'i is evidence of no impact.

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Jansen, J.K., Boveng, P.L., Dahle, S.P., and Bengtson, J.L. Reaction of harbor seals to cruise ships. *Journal of Wildlife Management* 74(6): 1186-1194, 2010.

**Notes:** The largest aggregations of harbor seals (*Phoca vitulina*) in Alaska, USA, haul out on floating ice in tidewater glacial fjords. Seals use these fjords in peak numbers during the critical periods of pupping, breeding, and molting when visits by tour ships also peak. Documented and suspected declines of harbor seals in fjords with rising vessel traffic underscore the need to better understand possible impacts, particularly in areas where ship visits have risen substantially in the past 2 decades. We examined the interruption of haul-out bouts of harbor seals due to approaching cruise ships in Disenchantment Bay, Alaska. We conducted observations from cruise ships and focused on disturbance of seals as evidenced by seals flushing into the water from the floating ice on which they rested. We investigated rate of flushing in relation to vessel distance, approach angle, group size, and seal type (mother, pup, or other). Using a survival-regression analysis, we found that the risk of disturbing harbor seals increased when ships approached within 500 m; seals approached as close as 100 m were 25 times more likely to enter the water than seals 500 m from a ship. Seals were 4 times more prone to enter the water when ships were approaching directly rather than passing abeam. Seals responded similarly regardless of group size or seal type. Energetic models indicated a potential to disrupt energy balance and cause thermal stress in disturbed pups if they spent >50% of their time in ice-chilled water. Studies at non-glacial sites suggest that pups spend 40-70% of their time in the water. Voluntary guidelines for approaching seals in Alaska recommend that cruise ships approach  $\geq 91$  m (100 yards), a distance at which we show 90% of seals would flush into the water. Our findings indicate a need to develop regulations to maintain a 500-m separation between cruise ships and seals in all Alaskan glacial fjords.

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Baker, C.S., Chilvers, B.L., Constantine, R., DuFresne, S., Mattlin, R.H., van Helden, A., and Hitchmough, R. Conservation status of New Zealand marine mammals (Suborders Cetacea and Pinnipedia), 2009. *New Zealand Journal of Marine and Freshwater Research* 44(2): 101-115, 2010.

**Notes:** The conservation status of New Zealand (NZ) marine mammals (suborders Cetacea and Pinnipedia) is reappraised using the 2008 version of the NZ Threat Classification System. The list comprises 56 taxa (named species or subspecies, and as yet unnamed forms or types) in the following categories: Threatened – eight taxa (five Nationally Critical and three Nationally Endangered); Vagrant – six taxa; Migrant – 20 taxa; and Data Deficient – 13 taxa. A further nine taxa are listed as Not Threatened. Relative to the previous listing, the threat status of two species worsened: the NZ sea lion (*Phocarctos hookeri*) was uplisted to Nationally Critical and the bottlenose dolphin (*Tursiops truncatus*) was uplisted to Nationally Endangered. No species was considered to have an improved status. With the uplisting of the NZ sea lion and the continued listing of the Hector's dolphin (*Cephalorhynchus hectori hectori*) as Endangered and Maui's dolphin (*C. hectori maui*) as Nationally Critical, all three endemic NZ marine mammals are now considered threatened with

extinction. We considered future research or management actions that would allow the downlisting of the eight taxa currently listed as Threatened.

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Jacobsen, J.K., Massey, L., and Gulland, F. **Fatal ingestion of floating net debris by two sperm whales (*Physeter macrocephalus*)**. *Marine Pollution Bulletin* 60(5): 765-767, 2010.

**Notes:** In 2008 two male sperm whales (*Physeter macrocephalus*) stranded along the northern California coast with large amounts of fishing net scraps, rope, and other plastic debris in their stomachs. One animal had a ruptured stomach, the other was emaciated, and gastric impaction was suspected as the cause of both deaths. There were 134 different types of nets in these two animals, all made of floating material, varying in size from 10 cm<sup>2</sup> to about 16 m<sup>2</sup>. The variability in size and age of the pieces suggests the material was ingested from the surface as debris rather than bitten off from active gear. These strandings demonstrate that ingestion of marine debris can be fatal to large whales, in addition to the well documented entanglements known to impact these species.

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Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., and Thompson, P.M. **Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals**. *Marine Pollution Bulletin* 60(6): 888-897, 2010.

**Notes:** Marine renewable developments have raised concerns over impacts of underwater noise on marine species, particularly from pile-driving for wind turbines. Environmental assessments typically use generic sound propagation models, but empirical tests of these models are lacking. In 2006, two 5 MW wind turbines were installed off NE Scotland. The turbines were in deep (>40 m) water, 25 km from the Moray Firth Special Area of Conservation (SAC), potentially affecting a protected population of bottlenose dolphins. We measured pile-driving noise at distances of 0.1 (maximum broadband peak to peak sound level 205 dB re 1  $\mu$ Pa) to 80 km (no longer distinguishable above background noise). These sound levels were related to noise exposure criteria for marine mammals to assess possible effects. For bottlenose dolphins, auditory injury would only have occurred within 100 m of the pile-driving and behavioural disturbance, defined as modifications in behaviour, could have occurred up to 50 km away.

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Jensen, S.K., Aars, J., Lydersen, C., Kovacs, K.M., and Asbakk, K. **The prevalence of *Toxoplasma gondii* in polar bears and their marine mammal prey: evidence for a marine transmission pathway?** *Polar Biology* 33(5): 599-606, 2010.

**Notes:** Little is known about the prevalence of the parasite *Toxoplasma gondii* in the arctic marine food chain of Svalbard, Norway. In this study, plasma samples were analyzed for *T. gondii* antibodies using a direct agglutination test. Antibody prevalence was 45.6% among polar bears (*Ursus maritimus*), 18.7% among ringed seals (*Pusa hispida*) and 66.7% among adult bearded seals (*Erignathus barbatus*) from Svalbard, but no sign of antibodies were found in bearded seal pups, harbour seals (*Phoca vitulina*), white whales (*Delphinapterus leucas*) or narwhals (*Monodon monoceros*) from the same area. Prevalence was significantly higher in male polar bears (52.3%) compared with females (39.3%), likely due to dietary differences between the sexes. Compared to an earlier study, *T. gondii* prevalence in polar bears has doubled in the past decade. Consistently, an earlier study on ringed seals did not detect *T. gondii*. The high recent prevalence in polar bears, ringed seals and bearded seals could be caused by an increase in the number or survivorship of oocysts being transported via the North Atlantic Current to Svalbard from southern latitudes. Warmer water temperatures have led to influxes of temperate marine invertebrate filter-feeders that could be vectors for oocysts and warmer water is also likely to favour higher survivorship of oocysts. However, a more diverse than normal array of migratory birds in the Archipelago recently, as well as a marked increase in cruise-ship and other human traffic are also potential sources of *T. gondii*.

Smith, P.A., Elliott, K.H., Gaston, A.J., and Gilchrist, H.G. **Has early ice clearance increased predation on breeding birds by polar bears?** *Polar Biology* 33(8): 1149-1153, 2010.

**Notes:** Past studies suggest that polar bears (*Ursus maritimus*) consume terrestrial food only opportunistically and derive little nutritional benefit from it. Here, we present observations of at least 6 bears consuming large numbers of snow goose (*Chen caerulescens*) eggs at two locations in the eastern low Arctic in 2004 and 2006. We also report two records of a polar bear eating the eggs and chicks of cliff-nesting thick-billed murres (*Uria lomvia*) in 2000 and 2003. Climatic warming has resulted in progressively earlier ice break-up in Hudson Bay, forcing bears ashore much earlier than historical records indicate. Advancement in the nesting dates of birds has been more modest, and this mismatch in timing could lead to an increasing overlap between the nesting period of birds and the period during which bears are on land. At these sites in these years, bears were on land prior to the hatch of nests, and the predation that ensued was catastrophic for the birds at a local scale. Although anecdotal, our observations highlight the complexity of trophic interactions that may occur in a changing Arctic.

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Levin, M., Joshi, D., Draghi, A., Gulland, F.M., Jessup, D., and De Guise, S. **Immunomodulatory effects upon in vitro exposure of California sea lion and southern sea otter peripheral blood leukocytes to domoic acid.** *Journal of Wildlife Diseases* 46(2): 541-550, 2010.

**Notes:** During red tide bloom events, the marine diatom *Pseudo-nitzschia* produces the toxin domoic acid (DA), which has been associated with stranding and mortality events involving California sea lions (*Zalophus californianus*) and southern sea otters (*Enhydra lutris*). In addition to these well-documented DA-induced neurotoxic events, there is increasing concern that DA may exert chronic effects, such as immunomodulation, which may potentially increase an individual's susceptibility to a number of opportunistic infections following nonlethal exposure. We investigated the effects of DA on innate (phagocytosis and respiratory burst) and adaptive (mitogen-induced lymphocyte proliferation) immune functions with the use of peripheral blood leukocytes collected from healthy California sea lions and southern sea otters upon in vitro exposure to 0 (unexposed control), 0.0001, 0.001, 0.01, 0.1, 1.0, 10, and 100  $\mu$ M DA. Domoic acid did not significantly modulate phagocytosis or respiratory burst in either species. For California sea lions, DA significantly increased ConA-induced T-lymphocyte proliferation upon exposure to DA concentrations ranging from 0.0001 to 10  $\mu$ M, resulting in a nonlinear dose-response curve. There was no effect on lymphocyte proliferation at the highest concentration of DA tested. No effects on lymphocyte proliferation were observed in southern sea otters. Importantly, the in vitro DA concentrations affecting T-cell proliferation were within or below the range of DA in serum measured in free-ranging California sea lions following natural exposure, suggesting a risk for immunomodulation in free-ranging animals. Understanding the risk for immunomodulation upon DA exposure will contribute in the health assessment and management of California sea lions and southern sea otters, as well as guide veterinarians and wildlife rehabilitators in caring for and treating afflicted animals.

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Spraker, T.R. and Lander, M.E. **Causes of mortality in northern fur seals (*Callorhinus ursinus*), St. Paul Island, Pribilof Islands, Alaska, 1986-2006.** *Journal of Wildlife Diseases* 46(2): 450-473, 2010.

**Notes:** To determine whether infectious diseases might have contributed to the present-day decline of northern fur seals (*Callorhinus ursinus*), preweaned pups ( $n = 2,735$ ), subadult males ( $n = 98$ ), and adults ( $n = 179$ ) were examined postmortem from 1986 to 2006 on St. Paul Island, Alaska. Gross necropsy findings and histologic lesions were used to determine causes of death. Five general categories of mortality were identified for pups: emaciation (1,454 pups, 53%), trauma (497 pups, 18%), perinatal mortality (516 pups, 19%), infectious diseases (82 pups, 3%), and miscellaneous causes (186 pups, 7%). A condition of unknown etiology characterized by multifocal necrotizing myopathy and cardiomyopathy was found in 92 pups. Thirty-three congenital anomalies were identified in 49 pups, including a rare multicentric ganglioneuro-blastoma. General linear models were used to examine change in pup mortality and condition (i.e., pup mass) over time. The prevalence of perinatal mortality appeared to increase during the study and relative to past reports. Trauma and infectious conditions appeared to decrease slightly from 1986 to 2006. Although relatively stable during this investigation, emaciation was greater than that reported for past studies. Emaciated pups weighed less than expected during 1988, 1996, and 2004 and more than expected during 1987, 1989, 1990, and 1994 ( $P \leq 0.003$ ).

Average annual weights for all other categories of mortality did not change significantly from 1986 to 2006. Fatal conditions for subadult males included hyperthermia, blunt trauma, entanglement, and bite wounds; nonfatal conditions included seizures, orange discoloration of the blubber, neoplasia, and parasitism. Causes of mortality for most adults included bite wounds with cellulitis and secondary infections, pulmonary edema, dystocia, blunt trauma, and neoplasia. We found no evidence to implicate infectious diseases as a cause in the recent decline of northern fur seals.

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Lefebvre, K.A., Robertson, A., Frame, E.R., Colegrove, K.M., Nance, S., Baugh, K.A., Wiedenhoft, H., and Gulland, F.M.D. **Clinical signs and histopathology associated with domoic acid poisoning in northern fur seals (*Callorhinus ursinus*) and comparison of toxin detection methods.** *Harmful Algae* 9(4): 374-383, 2010.

**Notes:** Between July 2005 and March 2009, 33 northern fur seals (*Callorhinus ursinus*) were collected after stranding along the central California coast between Sonoma and San Luis Obispo counties. Of these, 26 were collected live and could be observed for signs of neuroexcitotoxicity. Approximately half exhibited the classic clinical signs of domoic acid (DA) toxicosis including muscle twitches and ataxia, to seizures and coma, and had lesions in the central nervous system and heart. Several biological fluids were collected for DA analysis including aqueous humor, serum, stomach contents, feces, urine, abdominal fluid, amniotic fluid and milk. Four analytical methods were employed including receptor binding assay (RBA), enzyme-linked immunosorbent assay (ELISA), high performance liquid chromatography (HPLC-UV) and ultra performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS). The DA concentrations determined by each method were positively correlated. Domoic acid was detected in 83% of fecal samples collected from northern fur seals in the present study and in one animal was calculated to contain up to 18.6 µg DA/g. Interestingly, DA was detected and confirmed in the aqueous humor of the only animal this sample-type was collected from, suggesting that this may prove to be a useful diagnostic body fluid for algal toxin detection in marine mammal mortality events. These data document for the first time that northern fur seals are impacted by DA-producing harmful algal blooms along the California coast.

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Hall, A. J. and Frame, E. **Evidence of domoic acid exposure in harbour seals from Scotland: A potential factor in the decline in abundance?** *Harmful Algae* 9(5): 489-493, 2010.

**Notes:** The exposure of marine mammals to the toxins associated with harmful algae can be lethal. Domoic acid (DA) is a biotoxin produced by the *Pseudo-nitzschia* group of diatoms many of which are now a common component of the Scottish phytoplankton community (Stobo *et al.*, 2008). DA is a potent excitatory neurotoxin that has caused large-scale mortality of marine mammals. We found harbour seals (*Phoca vitulina*) in Scotland are exposed to DA. Low levels, likely from recent exposure, were measured in the faeces and urine of live captured adult animals (using a direct competitive enzyme linked immunosorbent assay) and exposure was highest during August-September 2008 (7/32 of the faecal (22%) and 11/29 (38%) of the urine samples were positive). Median concentrations in positive faeces and urine were 25 ng/g and 6 ng/ml respectively. One positive pregnant female was subsequently found dead with 10 ng/ml DA in her amniotic fluid but the contribution of DA exposure to the cause of death could not be established. However, the highest levels in the study were found in anonymous faecal samples collected in September 2009 on the east coast of Scotland (up to 397 ng/g). Further studies are urgently needed to determine the importance of DA exposure to the population dynamics of Scottish harbour seals in light of the recently reported major population declines.

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Mangel, M. **Scientific inference and experiment in Ecosystem Based Fishery Management, with application to Steller sea lions in the Bering Sea and Western Gulf of Alaska.** *Marine Policy* 34(5): 836-843, 2010.

**Notes:** Learning about ecosystem processes and patterns is an essential component of Ecosystem Based Fishery Management and the sustainable use of natural resources. Currently, such learning is usually done through adaptive management (passive or active) or Management Strategy Evaluation, which are explained. An example of adaptive management in northwestern Australia shows the strengths and limitations of management experiments and raises the question of how to learn if an experiment is not practicable. Both adaptive management and Management Strategy

Evaluation are examples of scientific inference, an idea introduced by Sir Harold Jeffreys nearly 80 years ago. With sufficient variation, even if it is not through controlled experiments, scientific inference is possible by combining mechanistic models with statistical methods; the recently proposed paradigm of 'adaptive monitoring' is another case of scientific inference. The decline of Steller sea lions in the Bering Sea and Aleutian Islands is reviewed, including the only work in which 10 hypotheses concerning the decline were simultaneously compared. It is concluded that scientific inference using mechanistic models and fine scale data at the level of the rookery can provide useful information about the interactions of fisheries, fish populations, and Steller sea lions.

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Alter, S.E., Simmonds, M.P., and Brandon, J.R. **Forecasting the consequences of climate-driven shifts in human behavior on cetaceans.** *Marine Policy* 34(5): 943-954, 2010.

**Notes:** While climate change is expected to affect cetaceans primarily via loss of habitat and changes in prey availability, additional consequences may result from climate-driven shifts in human behaviors and economic activities. For example, increases in shipping, oil and gas exploration and fishing due to the loss of Arctic sea ice are highly likely to exacerbate acoustic disturbance, ship strikes, bycatch and prey depletion for Arctic cetaceans. In the tropics, climate change may result in increased hunting pressure on near-shore dolphins and whales off Asia, Latin America, Africa, and elsewhere as the availability of other marine resources diminishes. This study explores the range of potential consequences to cetaceans worldwide from predicted climate-driven shifts in human behavior, and evaluates the risks to particular species given their geographic ranges and habitat preferences. While concern about impacts of climate change on cetaceans has largely focused on polar species, the analysis presented here suggests tropical coastal and riverine cetaceans such as the Irawaddy dolphin, Indo-Pacific humpback dolphin, and finless porpoise are particularly vulnerable to those aspects of climate change that are mediated by changes in human behavior. Policy recommendations include the following: (1) information about cetacean populations should be incorporated into national, regional and international climate adaptation decisions wherever possible (for example, via GEF-sponsored adaptation initiatives); and (2) human-mediated impacts of climate change should be included in cetacean conservation and management plans, such as the management procedures of the International Whaling Commission (IWC), where possible. Because human responses to climate change are likely to evolve rapidly over the coming years and decades, it is important that local, regional and international cetacean conservation and management plans include regular reviews to allow them to adapt to new information.

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Dolman, S. and Simmonds, M. **Towards best environmental practice for cetacean conservation in developing Scotland's marine renewable energy.** *Marine Policy* 34(5): 1021-1027, 2010.

**Notes:** Marine renewable energy is seen as an important component of the UK's future energy strategy and contribution to reducing the greenhouse gas emissions responsible for climate change. The UK aims to generate a total of 33GW (gigawatts) of offshore wind energy. Its implementation strategy includes the development of ten offshore wind farms within Scottish territorial waters. In addition, between 1000MW (megawatts) and 2600MW of marine renewable energy generating capacity could be achieved in Scotland using wave and tidal power devices. However, there are negative environmental impacts associated with marine renewable energy. Intense noise is produced during pile driving, drilling and dredging operations with potential consequences for cetaceans. There are also increases in vessel activities during exploration, maintenance and construction with association risks of disturbance and collisions. Some underwater devices will be large and may be positioned in arrays across the habitats that cetaceans frequent. The consequences of encounters between cetaceans and such devices are as yet unknown. It is recommended that the Scottish Government complete full and transparent Marine Spatial Planning, including consideration of cumulative impacts, before moving to license appropriate sites.

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Cisneros-Montemayor, A.M., Sumaila, U.R., Kaschner, K., and Pauly, D. **The global potential for whale watching.** *Marine Policy* 34(6): 1273-1278, 2010.

**Notes:** Whaling as a commercial enterprise is now defunct, not least due to the moratorium placed on it by the International Whaling Commission (IWC) almost 20 years ago. However, two distinct groups, one in favor of 'sustainable' whaling and one completely opposed to any killing of whales, continue to argue at the IWC and other political arenas. Almost ignored in this debate is the current growth of the whale watching industry, a logical alternative use for whale populations. Based on ecological and socio-economic criteria, the potential for whale watching is estimated for maritime countries that do not currently engage in this industry. Results suggest that whale watching could generate an additional 413 million USD (2009) in yearly revenue, supporting 5,700 jobs. Together with current global estimates, this would bring the total potential for the whale watching industry to over 2.5 billion USD in yearly revenue and about 19,000 jobs around the world. These results are discussed from an economic and conservation policy perspective, with emphasis on potential benefits and limitations.

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