

Marine Science Review - 160

Marine Mammals



In this review:

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

A. Recent articles – no abstract available

Inkelas, D. **Security, sound, and cetaceans: Legal challenges to low frequency active sonar under U.S. and international environmental law.** *George Washington International Law Review* 37(1): 207-249, 2005.

Leung, C.C.M., Jefferson, T.A., Hung, S.K., Zheng, G.J., Yeung, L.W.Y., Richardson, B.J., and Lam, P.K.S. **Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides and polychlorinated biphenyls in tissues of Indo-Pacific humpback dolphins from south China waters.** *Marine Pollution Bulletin* 50(12): 1713-1719, 2005.

B. Recent articles with abstracts

Demere, T.A., Berta, A., and McGowen, M.R. **The taxonomic and evolutionary history of fossil and modern balaenopteroid mysticetes.** *Journal of Mammalian Evolution* 12(1-2): 99-143, 2005.

Notes: Balaenopteroids (Balaenopteridae+Eschrichtiidae) are a diverse lineage of living mysticetes, with seven to ten species divided between three genera (*Megaptera*, *Balaenoptera* and *Eschrichtius*). Extant members of the Balaenopteridae (*Balaenoptera* and *Megaptera*) are characterized by their engulfment feeding behavior, which is associated with a number of unique cranial, mandibular, and soft anatomical characters. The Eschrichtiidae employ suction feeding, which is associated with arched rostra and short, coarse baleen. The recognition of these and other characters in fossil balaenopteroids, when viewed in a phylogenetic framework, provides a means for assessing the evolutionary history of this clade, including its origin and diversification. The earliest fossil balaenopterids include incomplete crania from the early late Miocene (7-10 Ma) of the North Pacific Ocean Basin. Our preliminary phylogenetic results indicate that the basal taxon, "*Megaptera*" *miocaena* should be reassigned to a new genus based on its possession of primitive and derived characters. The late late Miocene (5-7 Ma) balaenopterid record, except for *Parabalaenoptera baulinensis* and *Balaenoptera siberi*, is largely undescribed and consists of fossil specimens from the North and South Pacific and North Atlantic Ocean basins. The Pliocene record (2-5 Ma) is very diverse and consists of numerous named, but problematic, taxa from Italy and Belgium, as well as unnamed taxa from the North and South Pacific and eastern North Atlantic Ocean basins. For the most part Pliocene balaenopteroids represent extinct species and genera and reveal a greater degree of morphological diversity than at present. The Pleistocene record is very limited and, unfortunately, fails to document the evolutionary details leading to modern balaenopteroid species diversity. It is evident, however, that most extant species evolved during the Pleistocene. Morphological and molecular based phylogenies support two competing hypotheses concerning relationships within the Balaenopteroidea: (1) balaenopterids and eschrichtiids as sister taxa, and (2) eschrichtiids nested within a paraphyletic Balaenopteridae. The addition of fossil taxa (including a new Pliocene species preserving a mosaic of balaenopterid and eschrichtiid characters) in morphological and "total evidence" analyses, offers the potential to resolve the current controversy concerning the possible paraphyly of Balaenopteridae.

Wells, R.S., Tornero, V., Borrell, A., Aguilar, A., Rowles, T.K., Rhinehart, H.L., Hofmann, S., Jarman, W.M., Hohn, A.A., and Sweeney, J.C. **Integrating potential life-history and reproductive success data to examine relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida.** *The Science of the Total Environment* 349(1-3): 106-119, 2005.

Notes: Research initiated in 1970 has identified a long-term, year-round resident community of about 140 bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida, providing unparalleled opportunities to investigate relationships between organochlorine contaminant residues and life-history and reproductive parameters. Many individual dolphins are identifiable and of known age, sex, and maternal lineage (≤ 4 generations). Observational monitoring provides data on dolphin spatial and temporal occurrence, births and fates of calves, and birth-order. Capture-release operations conducted for veterinary examinations provide biological data and samples for life-history and contaminant residue measurement. Organochlorine concentrations in blubber and blood (plasma) can be examined relative to age, sex, lipid content, and birth-order. Reproductive success is evaluated through tracking of individual female lifetime calving success. For the current study, 47 blubber samples collected during June 2000 and 2001 were analyzed for PCB concentrations of 22 congeners relative to life-history factors and reproductive success. Prior to sexual maturity, males and females exhibited similar concentrations of about 15-50 ppm. Classical patterns of accumulation with age were identified in males, but not in females. Subsequently, males accumulated higher concentrations of PCBs through their lives (> 100 ppm), whereas females begin to depurate with their first calf, reaching a balance between contaminant intake and lactational loss (< 15 ppm). In primiparous females, PCB concentrations in blubber and plasma and the rates of first-born calf mortality were both high. First-born calves had higher concentrations than subsequent calves of similar age (> 25 vs. < 25 ppm). Maternal burdens were lower early in lactation and increased as calves approached nutritional independence. Empirical data were generally consistent with a published theoretical risk assessment and supported the need for incorporation of threats from indirect anthropogenic impacts such as environmental pollutants into species management plans. Long-term observational monitoring and periodic biological sampling provide a powerful, non-lethal approach to understanding relationships between organochlorine residue concentrations in tissues and reproductive parameters for coastal dolphins.

Adams, L.D. and Rosel, P.E. **Population differentiation of the Atlantic spotted dolphin (*Stenella frontalis*) in the western North Atlantic, including the Gulf of Mexico.** *Marine Biology* 148(3): 671-681, 2006.

Notes: Information about the genetic population structure of the Atlantic spotted dolphin [*Stenella frontalis* (G. Cuvier 1829)] in the western North Atlantic would greatly improve conservation and management of this species in USA waters. To this end, mitochondrial control region sequences and five nuclear microsatellite loci were used to test for genetic differentiation of Atlantic spotted dolphins in the western North Atlantic, including the Gulf of Mexico (n=199). Skin tissue samples were collected from 1994-2000. Significant heterozygote deficiencies in three microsatellite loci within samples collected off the eastern USA coast prompted investigation of a possible Wahlund effect, resulting in evidence for previously unsuspected population subdivision in this region. In subsequent analyses including three putative populations, two in the western North Atlantic (n=38, n=85) and one in the Gulf of Mexico (n=76), significant genetic differentiation was detected for both nuclear DNA ($R(ST)=0.096$, $P \leq 0.0001$) and mitochondrial DNA ($\Phi(ST)=0.215$, $P \leq 0.0001$), as well as for all pair-wise population comparisons for both markers. This genetic evidence for population differentiation coupled to known biogeographic transition zones at Cape Hatteras, North Carolina and Cape Canaveral, Florida, USA, evidence of female philopatry, and preliminary support for significant genetic differences between previously documented morphotypes of Atlantic spotted dolphins in coastal and offshore waters all indicate that the biology and life history of this species is more complex than previously assumed. Assumptions of large, panmictic populations might not be accurate in other areas where *S. frontalis* is continuously distributed (e.g., eastern Atlantic), and could have a detrimental effect on long-term viability and maintenance of genetic diversity in this species in regions where incidental human-induced mortality occurs.

Wolkers, H., Lydersen, C., Kovacs, K.M., Burkow, I., and Van Bavel, B. **Accumulation, metabolism, and food-chain transfer of chlorinated and brominated contaminants in subadult white whales (*Delphinapterus leucas*) and Narwhals (*Monodon monoceros*) from Svalbard, Norway.** *Archives of Environmental Contamination and Toxicology* 50(1): 69-78, 2006.

Notes: The concentrations and patterns of polychlorinated biphenyls (PCBs), chlorinated pesticides, and polybrominated diphenyl ethers (PBDEs) were studied in white whales (*Delphinapterus leucas*) and narwhals (*Monodon monoceros*) from Svalbard, Norway. In addition, their main food items were included in the study. In the whales, a broad range of pollutants was found in relatively high concentrations. PCBs and pesticides were approximately 3000 and 8000 ng/g lipid, respectively, for white whales and three times higher for narwhals. PBDEs 47 were approximately 70 ng/g lipid for white whales and 170 ng/g lipid for narwhals. Compared with other marine mammals from the same area, contaminant levels are among the highest levels ever measured. These high levels are likely in part because of a decreased capacity to metabolize contaminants. Metabolic indices indicated that most compounds accumulate to the same degree in white whales and narwhals, but for some toxaphenes and chlordanes, narwhals might have a decreased metabolism and consequently a higher accumulation. The three-times-higher contaminant levels in blubber of narwhals was further explained by substantially higher contaminant levels in their more benthic diet. The high levels and broad pattern of accumulating pollutants make white whales and narwhals excellent indicators for a wide range of contaminants in the Arctic.

Edwards, E.F. **Duration of unassisted swimming activity for spotted dolphin (*Stenella attenuata*) calves: implications for mother-calf separation during tuna purse-seine sets.** *Fishery Bulletin* 104(1): 125-135, 2006.

Notes: Size-related differences in power production and swim speed duration may contribute to the observed deficit of nursing calves in relation to lactating females killed in sets by tuna purse-seiners in the eastern tropical Pacific Ocean (ETP). Power production and swim-speed duration were estimated for northeastern spotted dolphins (*Stenella attenuata*), the species (neonate through adult) most often captured by the fishery. Power required by neonates to swim unassisted was 3.6 times that required of an adult to swim the same speed. Estimated unassisted burst speed for neonates is only about 3 m/s compared to about 6 m/s for adults. Estimated long-term sustainable speed is about 1 m/s for neonates compared to about 2.5 m/s for adults. Weight-specific power requirements decrease as dolphin calves increase in size, but power estimates for 2-year-old spotted dolphin calves are still about 40% higher than power estimates for adults, to maintain the same speed. These estimated differences between calves and adults are conservative because the calculations do not include accommodation for reduced aerobic capacity in dolphin calves compared to adults. Discrepancies in power production are probably ameliorated under normal circumstances by calves drafting next to their mothers, and by employing burst-coast or leap-burst-coast swimming, but the relatively high speeds associated with evasion behaviors during and after tuna sets likely diminish use of these energy-saving strategies by calves.

Sundaram, B., Poje, A.C., Veit, R.R., and Nganguia, H. **Acoustical dead zones and the spatial aggregation of whale strandings.** *Journal of Theoretical Biology* 238(4): 764-770, 2006.

Notes: Cetacean strandings display a marked geographical clustering. We propose a simple, two-dimensional ray-dynamics model of cetacean echolocation to examine the role played by coastline topography in influencing the location and clustering of stranding sites. We find that a number of coastlines known to attract cetacean strandings produce acoustical "Dead Zones" where echolocation signals are severely distorted by purely geometric effects. Using available cetacean stranding data bases from four disparate areas, we show that the geographical clusters in the observations correlate strongly with the regions of distorted echolocation signals as predicted by the model.

Baker, A.R., Loughlin, T.R., Burkanov, V., Matson, C.W., Trujillo, R.G., Calkins, D.G., Wickliffe, J.K., and Bickham, J.W. **Variation of mitochondrial control region sequences of Steller sea lions: The three-stock hypothesis.** *Journal of Mammalogy* 86(6): 1075-1084, 2005.

Notes: Sequence variation in the mitochondrial DNA (mtDNA) control region was analyzed from 1,568 individuals representing nearly every rookery ($n = 50$) at which Steller sea lions (*Eumetopias jubatus*) are known to breed in significant numbers. Rookeries were grouped into regions and regions into stocks to examine structure at different spatial scales. Haplotype diversity ($H = 0.9164 \pm 0.0035$) was high and nucleotide diversity ($\pi = 0.00967 \pm 0.00586$) was moderate. No evidence was observed for significant genetic bottleneck effects. Previous studies of mtDNA recognized 2 stocks (eastern and western) and suggested the presence of 2 groups within the western stock. In this study, significant ($P < 0.05$) divergence of eastern stock (southeastern Alaska to California) animals from western stock animals was supported in analyses at all spatial

scales. Likewise, rookeries and regions from Asia were found to be significantly different from all other western stock rookeries. This was most clearly demonstrated in regional comparisons. The Commander Islands rookery clearly associates with Alaskan western stock rookeries, not with the Asian rookeries. Within each of the 3 stocks there is significant isolation by distance among rookeries. This relationship does not hold for interstock comparisons, indicating that there are important barriers to gene flow among stocks. We recommend that the western stock be partitioned west of the Commander Islands, yielding a western stock that ranges from Prince William Sound west to the Commander Islands, and an Asian stock including rookeries from the Kamchatka Peninsula, Kuril Islands, and Sea of Okhotsk. The eastern stock remains unchanged and includes rookeries from southeastern Alaska through California.

Knowles, T.G. and Butterworth, A. **Immediate immobilisation of a Minke whale using a grenade harpoon requires striking a restricted target area.** *Animal Welfare* 15(1): 55-57, 2006.

Notes: Approximately 1500 Minke whales are killed annually under permit from the International Whaling Commission (IWC). This hunt supports a modest industry in Norway and in Japan; however, the welfare of whales during hunting and killing is such a cause of concern that in 1980 the IWC formed a sub-group entitled 'Working Group on Whole Killing Methods and Associated Welfare issues' devoted to discussing the issue. This commentary suggests that when using the Norwegian penthrite grenade-tipped harpoon ('Wholegrenade-99'), it is necessary to hit a relatively well-defined target area in order to effect an immediately immobile, and presumed unconscious state in the Minke whale

DeMaster, D.P., Trites, A.W., Clapham, P., Mizroch, S., Wade, P., Small, R.J., and Ver Hoef, J. **The sequential megafaunal collapse hypothesis: Testing with existing data.** *Progress in Oceanography* 68(2-4): 329-342, 2006.

Notes: Springer et al. [Springer, A.M., Estes, J.A., van Vliet, G.B., Williams, T.M., Doak, D.F., Danner, E.M., Forney, K.A., Pfister, B., 2003. Sequential megafaunal collapse in the North Pacific Ocean: an ongoing legacy of industrial whaling? *Proceedings of the National Academy of Sciences* 100 (21), 12,223-12,228] hypothesized that great whales were an important prey resource for killer whales, and that the removal of fin and sperm whales by commercial whaling in the region of the Bering Sea/Aleutian Islands (BSAI) in the late 1960s and 1970s led to cascading trophic interactions that caused the sequential decline of populations of harbor seal, northern fur seal, Steller sea lion and northern sea otter. This hypothesis, referred to as the Sequential Megafaunal Collapse (SMC), has stirred considerable interest because of its implication for ecosystem-based management. The SMC has the following assumptions: (1) fin whales and sperm whales were important as prey species in the Bering Sea; (2) the biomass of all large whale species (i.e., North Pacific right, fin, humpback, gray, sperm, minke and bowhead whales) was in decline in the Bering Sea in the 1960s and early 1970s; and (3) pinniped declines in the 1970s and 1980s were sequential. We concluded that the available data are not consistent with the first two assumptions of the SMC. Statistical tests of the timing of the declines do not support the assumption that pinniped declines were sequential. We propose two alternative hypotheses for the declines that are more consistent with the available data. While it is plausible, from energetic arguments, for predation by killer whales to have been an important factor in the declines of one or more of the three populations of pinnipeds and the sea otter population in the BSAI region over the last 30 years, we hypothesize that the declines in pinniped populations in the BSAI can best be understood by invoking a multiple factor hypothesis that includes both bottom-up forcing (as indicated by evidence of nutritional stress in the western Steller sea lion population) and top-down forcing (e.g., predation by killer whales, mortality incidental to commercial fishing, directed harvests). Our second hypothesis is a modification of the top-down forcing mechanism (i.e., killer whale predation on one or more of the pinniped populations and the sea otter population is mediated via the recovery of the eastern North Pacific population of the gray whale). We remain skeptical about the proposed link between commercial whaling on fin and sperm whales, which ended in the mid-1960s, and the observed decline of populations of northern fur seal, harbor seal, and Steller sea lion some 15 years later.

Allen, R.C. and Keay, I. **Bowhead whales in the eastern Arctic, 1611-1911: Population reconstruction with historical whaling.** *Environment and History* 12(1): 89-113, 2006.

Notes: As early as 1611 Bowhead whales resident between the east coast of Greenland and the island of Spitzbergen were the subject of intensive commercial hunting effort by Dutch, German and British whalers. By 1911 there was no significant, permanent population of Bowhead whales living in these waters. To understand the relationship between the commercial

exploitation of the Bowhead and their eventual extinction we must determine the chronology of their decline, starting with an estimate of the initial, pristine stock size. In this paper we compare and contrast four methodological approaches that can be used to estimate the Greenland-Spitzbergen Bowhead stock size prior to, and during, commercial exploitation. Using species-specific biological parameters, a delayed-difference recruitment model, and historical whaling records, we reconstruct the Greenland-Spitzbergen Bowhead population throughout the period of human predation. We estimate that there were approximately 52,500 adult Bowhead whales resident in the waters between the east coast of Greenland and the island of Spitzbergen in 1611.

David, J.A. **Likely sensitivity of bottlenose dolphins to pile-driving noise.** *Water and Environment Journal* 20(1): 48-54, 2006.

Notes: Pile driver-generated noise has the potential to affect dolphin populations adversely as it is detectable up to 40km from the source. At 9kHz, this noise is capable of masking strong vocalisations within 10-15km and weak vocalisations up to approximately 40km. The masking radius reduces as the frequency increases: 6km at 50kHz and 1.2km at 115kHz. The impacts of masking are expected to be limited by the intermittent nature of pile driver noise, the dolphin's directional hearing, their ability to adjust vocalisation amplitude and frequency, and the structured content of their signals. Behavioural modifications have been observed in response to underwater sounds, including those produced by pile drivers, although in the latter case this may have been due to redistribution of prey species. A range of mitigation measures are proposed that are aimed at reducing the impact of pile driver noise on dolphin populations.

Johnston, D.W., Friedlaender, A.S., Torres, L.G., and Lavigne, D.M. **Variation in sea ice cover on the east coast of Canada from 1969 to 2002: climate variability and implications for harp and hooded seals.** *Climate Research* 29(3): 209-222, 2005.

Notes: There is growing evidence that global change and climate variability are affecting sea ice dynamics in northern and eastern Canada. Such variability could have serious consequences for harp seals *Pagophilus groenlandicus* and hooded seals *Cystophora cristata*, which congregate to whelp on ice every February and March in the Gulf of St. Lawrence and off Newfoundland. We combined a numerical and spatial analysis of weekly averages of ice data to examine the variability of ice cover in eastern Canada during February and March, 1969 to 2002. Sea ice cover varied cyclically in eastern Canada during that time and exhibited a period of light ice years between 1996 and 2002. Spring thaw generally results in a significant reduction of sea ice cover throughout much of the study area, although some regions exhibit increases associated with oceanographic phenomena. Heavy ice years correlate with positive spring North Atlantic Oscillation (NAO) conditions and an in-depth analysis of highly anomalous (+/-) years (1970, 1972, 1981, 1993 and 2001) revealed consistent spatial and numerical patterns in ice dynamics. During light ice years, a synchronous and dramatic reduction in sea ice cover occurred in the Gulf and off eastern Newfoundland in the first and second week of March, coinciding with peak pupping periods for harp seals. Light ice years and rapid reductions in sea ice represent unquantified risks for pagophilic seals. These include increases in neonatal mortality, changes in food availability for pups and, possibly, increased risk of epizootics due to crowding on whelping patches. The magnitude of these risks may increase if observed changes in climate reduce sea ice cover in eastern Canada as they have in the Arctic. Patterns in sea ice cover and NAO conditions can be incorporated into short- and long-term management schemes aimed at ensuring the sustainability of commercially exploited pagophilic seal populations.

Sorice, M.G., Shafer, C.S., and Ditton, R.B. **Managing endangered species within the use preservation paradox: The Florida manatee (*Trichechus manatus latirostris*) as a tourism attraction.** *Environmental Management* 37(1): 69-83, 2006.

Notes: A significant challenge to wildlife managers in tourism settings is to provide visitors with opportunities to observe rare and endangered wildlife while simultaneously protecting the target species from deleterious impacts. Nearly 100,000 people annually visit Crystal River, Florida, USA to observe and swim with the Florida manatee, an endangered species. This research aimed to investigate and describe human-manatee interactions in a tourism context, to understand the salient issues related to such interactions as identified by stakeholders, and to recommend a course of action to address multiple interests in the planning and management of human-manatee interactions. Five issues were identified by all stakeholder groups: water quality, harassment, density and crowding, education, and enforcement. Currently, the U.S. Fish and Wildlife Service, which is

responsible for manatee management, does not have mechanisms in place to manage the tourism component of the manatee encounter. Although a regulatory approach can be taken, a better approach would be to create an organization of tour operators to establish "best practices" that reflect the goal of the managing agency to enhance manatee protection (and thus ensure their livelihood) and to enhance the visitor experience.

Muir, D.C.G., Backus, S., Derocher, A.E., Dietz, R., Evans, T.J., Gabrielsen, G.W., Nagy, J., Norstrom, R.J., Sonne, C., Stirling, I., Taylor, M.K., and Letcher, R.J. **Brominated flame retardants in polar bears (*Ursus maritimus*) from Alaska, the Canadian Arctic, East Greenland, and Svalbard.** *Environmental Science and Technology* 40(2): 449-455, 2006.

Notes: Polybrominated diphenyl ethers (PBDEs) were determined in adipose tissue of adult and subadult female polar bears sampled between 1999 and 2002 from sub-populations in Arctic Canada, eastern Greenland, and Svalbard, and in males and females collected from 1994 to 2002 in northwestern Alaska. Only 4 congeners (BDE47, 99, 100, and 153) were consistently identified in all samples. BDE47 was the major PBDE congener representing from 65% to 82% of the sum (Σ) PBDEs. Age was not a significant covariate for individual PBDEs or ΣPBDE. Higher proportions of BDE 99, 100, and 153 were generally found in samples from the Canadian Arctic than from Svalbard or the Bering-Chukchi Sea area of Alaska. Geometric mean ΣPBDE concentrations were highest for female polar bear fat samples collected from Svalbard (50 ng/g lipid weight (lw)) and East Greenland (70 ng/g lw). Significantly lower ΣPBDE concentrations were found in fat of bears from Canada and Alaska (means ranging from 7.6 to 22 ng/g lw). For the entire dataset, ΣPBDE concentrations were correlated with ΣPCBs. Higher total hexabromocyclododecane (HBCD) concentrations were found in fat of bears from Greenland and Svalbard than in those from Alaska. The geographical trends for PBDEs and HBCD parallel those for PCBs implying similar source regions for long range transport to the Arctic and bioaccumulation pathways in the arctic marine food web. All four major PBDE congeners were found to biomagnify from ringed seals to polar bears. BDE153 showed the greatest (71 x) biomagnification factors (BMFs) and, on average, had a BMF that was 5.5-fold higher than for PCB congener 153 (13x) but similar to PCB congener 194 (73x), indicating that it is a highly bioaccumulative compound.

Kanda, N., Goto, M., and Pastene, L. **Genetic characteristics of western North Pacific sei whales, *Balaenoptera borealis*, as revealed by microsatellites.** *Marine Biotechnology* 8(1): 86-93, 2006.

Notes: Genetic characteristics of sei whales, *Balaenoptera borealis*, inhabiting the western North Pacific were analyzed at 17 microsatellite loci in a total of 89 whales obtained from the area between 37°N - 45°N and 147°E - 166°E in 2002 (N = 39) and 2003 (N = 50). All the loci analyzed were polymorphic over the samples, some of the loci had more than 10 alleles, indicating a high level of genetic variation within samples. No significant deviation from the expected Hardy - Weinberg genotypic proportion was observed at the 17 loci in the samples. No evidence of genetic heterogeneity in allele frequencies was observed between sexes within samples as well as between the two temporally different samples, indicating a single population of sei whales inhabiting the western North Pacific. We finally tested and demonstrated that the population appeared not to suffer from genetic bottleneck as a result of population decline from past commercial whaling.

Read, A.J., Drinker, P., and Northridge, S. **Bycatch of marine mammals in U.S. and global fisheries.** *Conservation Biology* 20(1): 163-169, 2006.

Notes: Fisheries bycatch poses a significant threat to many populations of marine mammals, but there are few published estimates of the magnitude of these catches. We estimated marine mammal bycatch in U.S. fisheries from 1990 to 1999 with data taken from the stock assessment reports required by the US. Marine Mammal Protection Act. The mean annual bycatch of marine mammals during this period was 6215 +/- 448 (SE). Bycatch of cetaceans and pinnipeds occurred in similar numbers. Most cetacean (84%) and plumped (98%) bycatch occurred in gill-net fisheries. Marine mammal bycatch declined significantly over the decade, primarily because of a reduction in the bycatch of cetaceans. Total marine mammal bycatch was significantly lower after the implementation of take reduction measures in the latter half of the decade. We derived a crude first estimate of marine mammal bycatch in the world's fisheries by expanding U.S. bycatch with data on fleet composition from the Food and Agriculture Organization. The global bycatch of marine mammals is in the hundreds of thousands. Bycatch is likely to have significant demographic effects on many populations of marine mammals. Better data are urgently needed to fully understand the impact of these interactions.

Ross, P.S. **Fireproof killer whales (*Orcinus orca*): flame-retardant chemicals and the conservation imperative in the charismatic icon of British Columbia, Canada.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(1): 224-234, 2006.

Notes: Long-lived and high trophic level marine mammals are vulnerable to accumulating often very high concentrations of persistent chemicals, including pesticides, industrial by-products, and flame retardants. In the case of killer whales (*Orcinus orca*), some of the older individuals currently frequenting the coastal waters of British Columbia (BC) were born during the First World War, well before the advent of widespread chemical manufacture and use. BC's killer whales are now among the most polychlorinated biphenyl (PCB) contaminated marine mammals in the world. While the "legacy" PCBs have largely been banned, polybrominated diphenyl ethers (PBDEs) have recently emerged as a major concern. The endocrine-disrupting nature of these two persistent fire retardants in biota spells trouble at the top of the food chain, with increasing evidence of effects on reproductive health, the immune system, and development in exposed mammals. The heavy contamination of BC's killer whales, coupled with their long life span and high trophic level, highlights the need for a "weight of evidence" approach in research, conservation planning, and regulatory decisions. Given the global nature of contaminant dispersion, such approaches can only be effective when carried out on both national and international scales.

Dillingham, P.W., Skalski, J.R., and Ryding, K.E. **Fine-scale geographic interactions between Steller sea lion (*Eumetopias jubatus*) trends and local fisheries.** *Canadian Journal of Fisheries and Aquatic Sciences* 63(1): 107-119, 2006.

Notes: Fine-scale geographic interactions between Steller sea lion (*Eumetopias jubatus*) abundance trends and the abundance of local fisheries and commercial fishing efforts from Southeast Alaska to the Aleutian Islands were assessed. Census counts of Steller sea lions from 1976 to 2002 at 53 different trend sites and rookeries were grouped into 33 locales with similar population trends. Localized estimates of commercial groundfish biomass densities for walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), arrowtooth flounder (*Atheresthes stomias*), and Atka mackerel (*Pleurogrammus monoptyerygius*) from 1983 to 2002 and localized estimates of commercial fishing effort from 1990 to 2002 were matched to the 33 locales. Generalized estimating equations methods found a negative relationship between Steller sea lion abundance trends and walleye pollock density ($P < 0.10$). However, the 4.8-fold change in walleye pollock density between 1984 and 2001 was estimated to change the rate of population change (λ) by only 0.029. The analysis estimated that elimination of all trawl fishing effort would increase λ by as little as 0.0056. Neither commercial groundfish abundance nor commercial fishing effort could explain the large historical declines in the rate of Steller sea lion population change observed.

Robertson, B.C., Chilvers, B.L., Duignan, P.J., Wilkinson, I.S., and Gemmell, N.J. **Dispersal of breeding, adult male *Phocarcos hookeri*: Implications for disease transmission, population management and species recovery.** *Biological Conservation* 127(2): 227-236, 2006.

Notes: Dispersal impacts on a range of population parameters making it a key piece of information in species conservation. Despite its importance, dispersal is poorly characterized for many species: pinnipeds are no exception. Understanding dispersal patterns of the New Zealand sea lion *Phocarcos hookeri* is crucial in the conservation management of the species as its recovery to a non-threatened status hinges on range recolonisation. In this study, we examined the movements of breeding adult male New Zealand sea lions within and following the breeding season of the 2002/03 austral summer using a novel multi colony approach. Based on resightings of 202 individually identifiable adult males, we found (1) a previously unappreciated, high level of dispersal by adult territorial males between breeding colonies during the pupping period and (2) that breeding males disperse to the extremes of the species' range at the end of female oestrous. Our findings are contrary to the current paradigm of otariid breeding behaviour, which is believed to consist of prolonged, uninterrupted male territoriality based on intense male-male competition and sustained fasting. Adult male dispersal between colonies and across the species range has

important implications for adult males as vectors of disease in three recent epizootics, species management and species recovery via recolonisation as males are apparently remaining part of a localized, vulnerable breeding population.

Lemon, M., Lynch, T.P., Cato, D.H., and Harcourt, R.G. **Response of travelling bottlenose dolphins (*Tursiops aduncus*) to experimental approaches by a powerboat in Jervis Bay, New South Wales, Australia.** *Biological Conservation* 127(4): 363-372, 2006.

Notes: Powerboats are potentially a significant source of disturbance to coastal cetaceans. Information is scarce, however, on the nature of interactions between powerboats and dolphins, particularly when both surface and acoustic behaviour are combined. The surface behaviour and acoustic response of travelling dolphins to approaches by a powerboat were assessed by a series of experimental trials between November 2001 and November 2003 in Jervis Bay, New South Wales, Australia. Dolphin behaviour was monitored continuously from an independent research boat before, during and after a powerboat approached (n = 12). Treatments were interspersed with control observations (n = 12). Changes in surface behaviour indicated differences between the treatment and control periods ($z = 2.24$, $p = 0.025$), with dolphins tending to alter their surface behaviour when exposed to the powerboat approach. Analysis also revealed a change in the direction of travel by dolphin groups when approached ($z = 3.22$, $p = 0.001$). Changes in surface behaviour occurred at vessel approach distances outside the minimum approach distance of 30 m for recreational and commercial vessels, as proposed by the New South Wales National Parks and Wildlife Service. In contrast, there were no changes in dolphin whistle rates ($F_{3,12} = 0.74$, $p = 0.54$) or the duration of echolocation click bouts ($F_{3,12} = 0.76$, $p = 0.59$) when approached. These findings indicate that powerboats do affect the surface behaviour and direction of travelling inshore bottlenose dolphins in Jervis Bay; however it appears that this impact is not reflected in their acoustic behaviour.

Escorza-Trevino, S., Archer, F.I., Rosales, M., Lang, A.M., and Dizon, A.E. **Genetic differentiation and intraspecific structure of Eastern Tropical Pacific spotted dolphins, *Stenella attenuata*, revealed by DNA analyses.** *Conservation Genetics* 6(4): 587-600, 2005.

Notes: Mitochondrial DNA (mtDNA) control region sequences and microsatellite loci length polymorphisms were used to investigate genetic differentiation in spotted dolphins (*Stenella attenuata*) in the Eastern Tropical Pacific and to examine the intraspecific structure of the coastal subspecies (*Stenella attenuata graffmani*). One-hundred and thirty-five animals from several coastal areas and 90 offshore animals were sequenced for 455 bp of the mitochondrial control region, resulting in 112 mtDNA haplotypes. Phylogenetic analyses and the existence of shared haplotypes between the two subspecies suggest recent and/or current gene flow. Analyses using χ^2 , F-ST (based on haplotype frequencies) and Phi(ST) values (based on frequencies and genetic distances between haplotypes) yielded statistically significant separation (randomized permutation values $P < 0.05$) among four different coastal populations and between all but one of these and the offshore subspecies (overall $F_{ST} = 0.0691$). Ninety-one coastal animals from these four geographic populations and 50 offshore animals were genotyped for seven nuclear microsatellite loci. Analysis using F-ST values (based on allelic frequencies) yielded statistically significant separation between most coastal populations and offshore animals, although no coastal populations were distinguished. These results argue for the existence of some genetic isolation between offshore and inshore populations and among some inshore populations, suggesting that these should be treated as separate units for management purposes.

Sellas, A.B., Wells, R.S., and Rosel, P.E. **Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico.** *Conservation Genetics* 6(5): 715-728, 2005.

Notes: There is a need for biological information to support current stock designations of bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. The existence of many inshore, resident "communities" raises questions as to the relationship these dolphins may hold with dolphins inhabiting neighboring inshore and coastal areas. In this study, population subdivision was examined among four resident, inshore bottlenose dolphin stocks (Sarasota Bay, FL, Tampa Bay, FL, Charlotte Harbor, FL and Matagorda Bay, TX) and one coastal stock (1- 12 km offshore) in the Gulf of Mexico. Evidence of significant population structure among all areas was found on the basis of both mitochondrial DNA (mtDNA) control region sequence data and nine nuclear microsatellite loci. Estimates of relatedness showed no population contained a significantly high number of related individuals, while separate AMOVAs for males and females indicated that both sexes exhibit a significant level of

site philopatry. Results presented here provide the first genetic evidence of population subdivision between the coastal Gulf of Mexico and adjacent inshore areas along the central west coast of Florida. Such strong genetic subdivision is surprising given the short geographical distance between many of these areas and the lack of obvious geographic barriers to prevent gene flow. These findings support the current, separate identification of stocks for bottlenose dolphins inhabiting the eastern coastal and inshore areas of the Gulf of Mexico.

Riget, F., Vikelsoe, J., and Dietz, R. **Levels and temporal trends of PCDD/PCDFs and non-ortho PCBs in ringed seals from East Greenland.** *Marine Pollution Bulletin* 50(12): 1523-1529, 2005.

Notes: The levels and temporal trend of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) and non-ortho substituted PCBs (c-PCBs, i.e. CB77, CB126 and CB169) were determined in ringed seal blubber from central East Greenland collected in 1986, 1994, 1999 and 2003, respectively. Since 1986 the concentrations of PCDDs, PCDFs and c-PCBs all show a decreasing trend. The annual decreases were estimated to 5.2% and 5.3% for pg/g WHO-TEQ ww of PCDD/Fs and c-PCB, respectively. The annual median concentrations of PCDDs ranged from 5.4 to 24.4 pg/g WHO-TEQ ww and those of PCDFs from 2.5 to 5.1 pg/g WHO-TEQ ww. Compared to PCDD/Fs concentrations in ringed seals from other Arctic areas the levels of PCDD/Fs found in 1986 were the highest recorded. The annual median concentrations of c-PCBs decreased 24.2 to 9.1 pg/g WHO-TEQ ww. The levels of c-PCBs observed in 1986 are similar to levels found in ringed seals from Svalbard in 1990 and from eastern Hudson Bay in 1989-1992. The dominant and most TEQ-contributing PCDD congener was 1,2,3,7,8-PeCDD. CB126 was the dominating and most TEQ-contributing c-PCB congener. The concentrations of PCDDs, PCDFs and c-PCBs were highly significantly inter-correlated. Principal component analysis of the PCDD/PCDF congeners and c-PCBs was performed to analyse the pattern of compounds during time.

Ramu, K., Kajiwara, N., Tanabe, S., Lam, P.K.S., and Jefferson, T.A. **Polybrominated diphenyl ethers (PBDEs) and organochlorines in small cetaceans from Hong Kong waters: Levels, profiles and distribution.** *Marine Pollution Bulletin* 51(8-12): 669-676, 2005.

Notes: Polybrominated diphenyl ethers (PBDEs) and organochlorine compounds (OCs) were determined in the blubber, liver and kidney of Indo-Pacific humpback dolphins (*Sousa chinensis*) and finless porpoises (*Neophocaena phocaenoides*) stranded in Hong Kong coastal waters during 1995-2001. Among the organohalogen compounds analyzed, DDTs were the most dominant contaminants with concentrations ranging from 9.9 to 470 mg/g lipid wt. PBDEs in Hong Kong cetaceans, which are reported for the first time, were detected in all the samples with values ranging from 0.23 to 6.0 mg/g lipid wt., with a predominance of BDE-47. Results from this study suggest PBDEs should be classified as priority pollutants in Asia. Higher concentrations were found in humpback dolphins than in finless porpoises, and this was attributed mainly to differences in habitat. Elevated residues of PCBs and DDTs in some cetaceans suggest these species may be at risk.

Heide-Jorgensen, M.P., Laidre, K.L., Jensen, M.V., Dueck, L., and Postma, L.D. **Dissolving stock discreteness with satellite tracking: Bowhead whales in Baffin Bay.** *Marine Mammal Science* 22(1): 34-45, 2006.

Notes: Nine bowhead whales (*Balaena mysticetus*) were instrumented with satellite transmitters in West Greenland in May 2002 and 2003. Transmitters were either encased in steel cans or imbedded in floats attached to wires. Transmitters mounted in steel cans had a high initial failure rate, yet those that were successful provided tracking durations up to seven months. Float tags had a low initial failure rate and initially provided large numbers of positions; however, they had deployment durations of only 2-33 d. All tracked whales departed from West Greenland and headed northwest towards Lancaster Sound in the end of May. Three tags with long tracking durations (197-217 d) recorded movements of whales (1 male, 2 female) into December in 2002 and 2003. All of these individuals remained within the Canadian High Arctic or along the east coast of Baffin Island in summer and early fall. By the end of October, all three whales moved rapidly south along the east coast of Baffin Island and entered Hudson Strait, an apparent wintering ground for the population. One of the whales did not visit Isabella Bay on east Baffin Island, the locality used for abundance estimation from photographic reidentification of individuals. The movements of whales tagged in this study raise critical questions about the assumed stock discreteness of bowhead whales in Foxe Basin, Hudson Strait, and Davis Strait and indicate current estimates of abundance are negatively biased.

Winship, A.J. and Trites, A.W. **Risk of extirpation of Steller sea lions in the Gulf of Alaska and Aleutian Islands: A population viability analysis based on alternative hypotheses for why sea lions declined in western Alaska.** *Marine Mammal Science* 22(1): 124-155, 2006.

Notes: We estimated the risk that the Steller sea lion will be extirpated in western Alaska using a population viability analysis (PVA) that combined simulations with statistically fitted models of historical population dynamics. Our analysis considered the roles that density-dependent and density-independent factors may have played in the past, and how they might influence future population dynamics. It also established functional relationships between population size, population growth rate and the risk of extinction under alternative hypotheses about population regulation and environmental variability. These functional relationships can be used to develop recovery criteria and guide research and management decisions. Life table parameters (e.g., birth and survival rates) operating during the population decline (1978-2002) were estimated by fitting simple age-structured models to time-series of pup and non-pup counts from 33 rookeries (subpopulations). The PVA was carried out by projecting all 33 subpopulations into the future using these estimated site-specific life tables (with associated uncertainties) and different assumptions about carrying capacities and the presence or absence of density-dependent population regulation. Results suggest that the overall predicted risk of extirpation of Steller sea lions as a species in western Alaska was low in the next 100 yr under all scenarios explored. However, most subpopulations of Steller sea lions had high probabilities of going extinct within the next 100 yr if trends observed during the 1990s were to continue. Two clusters of contiguous subpopulations occurring in the Unimak Pass area in the western Gulf of Alaska/eastern Aleutian Islands and the Seguam-Adak region in the central Aleutian Islands had relatively lower risks of extinction. Risks of extinction for a number of subpopulations in the Gulf of Alaska were reduced if the increases observed since the late 1990s continue into the future. The risks of subpopulations going extinct were small when density-dependent compensation in birth and survival rates was assumed, even when random stochasticity in these vital rates was introduced.

Mathews, E.A. and Pendleton, G.W. **Declines in harbor seal (*Phoca vitulina*) numbers in Glacier Bay National Park, Alaska, 1992-2002.** *Marine Mammal Science* 22(1): 167-189, 2006.

Notes: Glacier Bay National Park had one of the largest breeding aggregations of harbor seals in Alaska, and it is functionally the only marine reserve for harbor seals in Alaska; yet, numbers of seals in the Bay are declining rapidly. Understanding why seals in Glacier Bay are declining may clarify their minimal habitat needs. We estimated population trends using models that controlled for environmental and observer-related factors. In 1992, 6,200 seals were counted on icebergs in a tidewater glacial fjord and at terrestrial sites; by 2002 only 2,550 seals were counted at these same haul-outs. Numbers of non-pups in the glacial fjord declined by 6.6%/yr (-39%/8 yr) in June and by 9.6%/yr (-63%/11 yr) in August and at all other haul-outs by 14.5%/yr (-75%/10 yr) during August. In the glacial fjord the number of pups remained steady from 1994 to 1999 and made up an increasing proportion of seals counted (5.4%/yr), and the proportion of pups peaked at 34%-36%. The rapid declines do not appear to be due to changes in seal behavior or redistribution. The declines reinforce genetic evidence that harbor seals in Glacier Bay are demographically isolated from other populations and indicate that current management stocks need to be redefined. Changes in Glacier Bay's ecosystem and population demographic data from the glacial fjord suggest that interspecific competition and predation are likely factors in the declines.