

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

Sanderson, H. et al. Environmental hazards of sea-dumped chemical weapons. *Environmental Science and Technology* 44(12): 4389-4394, 2010. O/A

Kaiser, J. The dirt on ocean garbage patches. *Science* 328(5985): 1506, 2010.

B. Recent articles with abstracts

Barnes, D.K.A., Walters, A., and Goncalves, L. Macroplastics at sea around Antarctica. *Marine Environmental Research* 70(2): 250-252, 2010.

Notes: More so than at any previous time, there is a heightened awareness of the amount of plastic in the environment, its spread to even remote localities and the multiple influences of this on organisms. In the austral summer of 2007/08 Greenpeace and British Antarctic Survey ships (*MV Esperanza* and *RRS James Clark Ross* respectively) conducted the first co-ordinated joint marine debris survey of the planet's most remote seas around East and West Antarctica to reveal floating macroplastics. With observations also made from the ice patrol vessel *HMS Endurance* in the same season and seabed samples collected from the *RRS James Clark Ross*, this was the widest survey for plastics ever undertaken around Antarctica. Main features: The 2008 visit of *RRS James Clark Ross* to the Amundsen Sea breached two last frontiers; the last and most remote sea from which biological samples and plastic debris have been reported. A plastic cup and two fishing buoys were seen in the Durmont D'Urville and Davis seas while two pieces of plastic packaging and a fishing buoy were observed in the Amundsen Sea. Agassiz trawls revealed rich biodiversity on the Amundsen (and south Bellingshausen) seabed but no sunken plastic pieces. We found no microplastics in five epibenthic sledge samples (300 µm mesh) from the Amundsen seabed. The seabeds immediately surrounding continental Antarctica are probably the last environments on the planet yet to be reached by plastics, but with pieces floating into the surface of the Amundsen Sea this seems likely to change soon. Our knowledge now touches every sea but so does our legacy of lost and discarded plastic.

Law, K.L., Moret-Ferguson, S., Maximenko, N.A., Proskurowski, G., Peacock, E.E., Hafner, J., and Reddy, C.M. **Plastic accumulation in the North Atlantic subtropical gyre.** *Science* 329(5996): 1185-1188, 2010.

Notes: Plastic marine pollution is a major environmental concern, yet a quantitative description of the scope of this problem in the open ocean is lacking. Here, we present a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008. More than 60% of 6136 surface plankton net tows collected buoyant plastic

pieces, typically millimeters in size. The highest concentration of plastic debris was observed in subtropical latitudes and associated with the observed large-scale convergence in surface currents predicted by Ekman dynamics. Despite a rapid increase in plastic production and disposal during this time period, no trend in plastic concentration was observed in the region of highest accumulation.

Costa, M.F., do Sul, J.A.I., Silva-Cavalcanti, J.S., Araujo, M.C.B., Spengler, A., and Tourinho, P.S. **On the importance of size of plastic fragments and pellets on the strandline: a snapshot of a Brazilian beach.** *Environmental Monitoring and Assessment* 168(1-4): 299-304, 2010.

Notes: Virgin plastic pellets and plastic fragments are reported as ubiquitous beach contaminants in the peer-reviewed literature. A surface density of 0.3 virgin plastic pellets and plastic fragments per square centimeter of the strandline area was registered on an urban beach of the northeast of Brazil. This beach is presently not affected by petrochemical facilities or pellet processing plants. The main source of fragments (96.7%) was attributed to the breaking down of larger plastic items deposited on the beach. In the case of virgin plastic pellets (3.3%), the main sources were the marine environment and possibly nearby port facilities. This category of plastic pollutant offers particular threats to the marine environment and to beach users.

Christiansen, J.S., Karamushko, L.I., and Nahrgang, J. **Sub-lethal levels of waterborne petroleum may depress routine metabolism in polar cod *Boreogadus saida* (Lepechin, 1774).** *Polar Biology* 33(8): 1049-1055, 2010.

Notes: Petroleum-related activities in Arctic waters are rapidly increasing parallel to the ongoing thinning of the Arctic sea ice. As part of a series of studies on petroleum-induced stress in polar cod *Boreogadus saida*, we tested the effects of acute (~60 min) and chronic (4 weeks) exposure to the water soluble fraction (WSF) of petroleum on whole body metabolism inferred from measurements of oxygen consumption rates. The exposure of polar cod to WSF leads to a statistically significant depression in routine metabolism in the order Control (0.260 mg O₂ g fish⁻¹ h⁻¹; N = 6) > Chronic (0.191 mg O₂ g fish⁻¹ h⁻¹; N = 6) > Acute (0.110 mg O₂ g fish⁻¹ h⁻¹; N = 2), decoupling of routine metabolism and body mass but possibly also to a partial metabolic compensation after 4 weeks of exposure. The results are reviewed in context with similar studies on Antarctic and non-polar fishes.

Deasi, S.R., Verlecar, X.N., Ansari, Z.A., Jagtap, T.G., Sarkar, A., Vashistha, D., and Dalal, S.G. **Evaluation of genotoxic responses of *Chaetoceros tenuissimus* and *Skeletonema costatum* to water accommodated fraction of petroleum hydrocarbons as biomarker of exposure.** *Water Research* 44(7): 2235-2244, 2010.

Notes: Genotoxic responses towards chronic exposure of *Chaetoceros tenuissimus* and *Skeletonema costatum* to water accommodated fraction of petroleum hydrocarbons (WAF-P) were evaluated as biomarkers of petroleum hydrocarbons pollution. The DNA damage caused by water accommodated fraction of petroleum hydrocarbons was assessed in terms of the DNA integrity measured by alkaline unwinding assay. The comparative study of the growth pattern of *C. tenuissimus* with respect to DNA integrity and the DNA strand breaks in different concentrations of WAF-P showed sufficient tolerance. However, its toxicity increased proportionately with exposure to elevated levels of WAF-P. Although DNA damage in *S. costatum* was similar to *C. tenuissimus*, its tolerance level to WAF-P was at least 5 times lower than that of *C. tenuissimus* indicating its high sensitivity to petroleum hydrocarbons. Active growth was exhibited by *C. tenuissimus* between 10 and 20% WAF-P (ranging from 0.59 to 1.18 mg/L petroleum hydrocarbons) which can be related to the polluted regions only, suggesting the tolerant nature of this organism. Considering the degree of sensitivity to petroleum products and good growth under laboratory conditions, these two diatoms could be recommended as model species for evaluating ecogenotoxic effects of wide range of petroleum hydrocarbon pollutants using alkaline unwinding assays.

Veiga, P., Besteiro, C., and Rubal, M. **Meiofauna communities in exposed sandy beaches on the Galician coast (NW Spain), six months after the Prestige oil spill: the role of polycyclic aromatic hydrocarbons (PAHs).** *Scientia Marina* 74(2): 385-394, 2010. O/A

Notes: The effect of polycyclic aromatic hydrocarbons (PAHs) on Galician sandy beach ecosystems, six months after the Prestige oil spill, was evaluated using the meiobenthos at a higher taxon level as an indicator. Meiobenthos community structure, environmental variables and sediment PAH content from six affected exposed beaches were studied and compared with three reference sites. They were also compared with data from polluted beaches obtained during the first days of the spill. Significant amounts of PAHs were found in affected beach sediments and both univariate and multivariate analyses showed differences between affected and reference beaches. Correlation analyses between PAH content and the meiobenthos community structure showed that 1,2-dimethylnaphthalene (C2-NAPH) and 1-methylphenanthrene (C-PHEN) affected both the community structure and the abundance of the main taxa. These two PAHs seem to be responsible for the low meiofauna density values, which suggests that there is a relationship between the oil spill and the differences between affected and reference localities.

Koivula, M.J. and Eeva, T. **Metal-related oxidative stress in birds.** *Environmental Pollution* 158(7): 2359-2370, 2010.

Notes: Metals can cause oxidative stress by increasing the formation of reactive oxygen species (ROS), which render antioxidants incapable of defence against growing amounts of free radicals. Metal toxicity is related to their oxidative state and reactivity with other compounds. Our aim is to review the mechanisms on how metals cause oxidative stress and what is known about metal-induced oxidative stress in wildlife. Taking birds as model organisms, we summarize the mechanisms responsible for antioxidant depletion and give a view of how to detect metal-induced oxidative stress in birds by using different biomarkers. The mechanisms producing the harmful effects of oxidative stress are complex with different biomolecular mechanisms associated with ecotoxicological and ecological aspects. The majority of the studies concerning metals and ROS related to oxidative stress have focused on the biomolecular level, but little is known about the effects at the cellular level or at the level of individuals or populations.

Ramakrishnan, B., Megharaj, M., Venkateswarlu, K., Naidu, R., and Sethunathan, N. **The impacts of environmental pollutants on microalgae and cyanobacteria.** *Critical Reviews in Environmental Science and Technology* 40(8): 699-821, 2010.

Notes: Efforts are continuously being made to understand the non-target effects of environmental pollutants toward microalgae and cyanobacteria because of their ubiquity in aquatic and terrestrial environments and their highly adaptive survival abilities under environmental and evolutionary pressure over geological time. Depending on the toxicity criteria employed for these ecologically beneficial organisms, the impact of low and high doses of pollutants can range from stimulation to total inhibition. All of the investigations carried out so far have been predominantly concerned with individual chemicals despite the occurrence of pollutants in mixtures. In addition, only individual isolates have been primarily used to gather scientific information on the toxicity of pollutants. The risk assessment of pollutants toward these organisms necessitates further investigations, combining innovative molecular ecological methods and those for in situ analysis at the community level. The present review highlights the toxic influences of organic and inorganic pollutants and the response in terms of detoxification and resistance by these organisms.

Gilbert, D., Rabalais, N.N., Diaz, R.J., and Zhang, J. **Evidence for greater oxygen decline rates in the coastal ocean than in the open ocean.** *Biogeosciences* 7(7): 2283-2296, 2010. O/A

Notes: In the global ocean, the number of reported hypoxic sites (oxygen < 30% saturation) is on the rise both near the coast and in the open ocean. But unfortunately, most of the papers on hypoxia only present oxygen data from one or two years, so that we often lack a long-term perspective on whether oxygen levels at these locations are decreasing, steady or increasing. Consequently, we cannot rule out the possibility that many of the newly reported hypoxic areas were hypoxic in the past, and that the increasing number of hypoxic areas partly reflects increased research and monitoring efforts. Here we address this

shortcoming by computing oxygen concentration trends in the global ocean from published time series and from time series that we calculated using a global oxygen database. Our calculations reveal that median oxygen decline rates are more severe in a 30 km band near the coast than in the open ocean (>100 km from the coast). Percentages of oxygen time series with negative oxygen trends are also greater in the coastal ocean than in the open ocean. Finally, a significant difference between median published oxygen trends and median trends calculated from raw oxygen data suggests the existence of a publication bias in favor of negative trends in the open ocean.

Macdonald, R.W. and Loseto, L.L. **Are Arctic Ocean ecosystems exceptionally vulnerable to global emissions of mercury? A call for emphasised research on methylation and the consequences of climate change.** *Environmental Chemistry* 7(2): 133-138, 2010.

Notes: Emissions, atmospheric transport and deposition have formed the emphasis of recent research to understand Hg trends in Arctic marine biota, with the expressed objective of predicting how biotic trends might respond to emission controls. To answer the question of whether the Arctic Ocean might be especially vulnerable to global mercury (Hg) contamination and how biota might respond to emission controls requires a distinction between the supply of Hg from source regions and the processes within the Arctic Ocean that sequester and convert mercury to monomethyl Hg (MeHg). Atmospheric Mercury Depletion Events (AMDEs) provide a unique Hg deposition process in the Arctic; however, AMDEs have yet to be linked quantitatively with Hg uptake in marine food webs. The difficulty in implicating AMDEs or emissions to biotic trends lie in the ocean where several poorly understood processes lead to MeHg production and biomagnification. We propose that sensitivity of the Arctic Ocean's ecosystem to Hg lies not so much in the deposition process as in methylation processes within the ocean, Hg inputs from large drainage basins, and the vulnerability of these to climate change. Future research needs to be better balanced across the entire Hg cycle.

Pacyna, E.G., Pacyna, J.M., Sundseth, K., Munthe, J., Kindbom, K., Wilson, S., Steenhuisen, F., and Maxson, P. **Global emission of mercury to the atmosphere from anthropogenic sources in 2005 and projections to 2020.** *Atmospheric Environment* 44(20): 2487-2499, 2010.

Notes: This paper presents the 2005 global inventory of anthropogenic emissions to the atmosphere component of the work that was prepared by UNEP and AMAP as a contribution to the UNEP report Global Atmospheric Mercury Assessment: Sources, Emissions and Transport (UNEP Chemicals Branch, 2008). It describes the methodology applied to compile emissions data on the two main components of the inventory – the 'by-product' emissions and the 'intentional use' emissions – and to geospatially distribute these emissions estimates to produce a gridded dataset for use by modelers, and the results of this work. It also presents some initial results of work to develop (simplified) scenario emissions inventories for 2020 that can be used to investigate the possible implications of actions to reduce mercury emissions at the global scale.

Missiaen, T., Soderstrom, M., Popescu, I., and Vanninen, P. **Evaluation of a chemical munition dumpsite in the Baltic Sea based on geophysical and chemical investigations.** *The Science of the Total Environment* 408(17): 3536-3553, 2010.

Notes: This paper discusses the results of geophysical and chemical investigations carried out in a chemical munition dumpsite in the southern Baltic Sea, east of the island of Bornholm. After WW2 over 32,000 tons of chemical war material was dumped here including shells and bombs as well as small drums and containers. The geophysical investigations combined very-high-resolution seismics and gradiometric measurements. The results indicate the presence of a large number of objects buried just below the seafloor. The size of the objects and their distribution, with a marked increase in density towards the center of the dumpsite, suggests that we are dealing with dumped war material. Sediment and near-bottom water samples, taken within the dumpsite and in the surrounding area, were analysed for the presence of various chemical warfare agents (CWA) including Adamsite, Clark, sulphur mustard, tabun, chlorobenzene and arsine oil. The results indicate a widespread contamination that reaches far beyond the dumpsite boundary. CWA degradation products were found in most of the sediment samples. The contamination was mostly related to arsenic containing compounds; only one sample indicated the

presence of sulfur mustard. Although the correlation between detected objects and CWA concentrations is not always straightforward, the overall results suggest that a lot of the dumped war material is leaking and that over the years the contamination has reached the seafloor sediments.

Ericson, H., Thorsen, G., and Kumblad, L. **Physiological effects of diclofenac, ibuprofen and propranolol on Baltic Sea blue mussels.** *Aquatic Toxicology* 99(2): 223-231, 2010.

Notes: Pharmaceuticals are constantly dispersed into the environment and little is known of the effects on non-target organisms. This is an issue of growing concern. In this study, Baltic Sea blue mussels, *Mytilus edulis trossulus*, were exposed to diclofenac, ibuprofen and propranolol, three pharmaceuticals that are produced and sold in large quantities and have a widespread occurrence in aquatic environments. The mussels were exposed to pharmaceuticals in concentrations ranging from 1 to 10,000 µg l⁻¹. The pharmaceuticals were added both separately and in combination. Mussels exposed to high concentrations of pharmaceuticals showed a clear response compared to controls. Firstly, they had a significantly lower scope for growth, which indicates that the organisms had a smaller part of their energy available for normal metabolism, and secondly, they had lower byssus strength and lower abundance of byssus threads, resulting in reduced ability to attach to the underlying substrate. Mussels exposed to lower concentrations showed tendencies of the same results. The concentration of diclofenac and propranolol was quantified in the mussels using both liquid chromatography coupled to mass spectrometry (LC-MS). The measurements showed a significantly higher concentration in the organisms as compared to the water the mussels were exposed to; the uptake reached concentrations two orders of magnitudes higher than found in sewage treatment plant effluents. This study showed that common pharmaceuticals are taken up and negatively affect the physiology of a non-target species at levels of two to three orders of magnitudes higher than found in sewage treatment plant effluents.

Gorokhova, E., Löf, M., Halldórsson, H.P., Tjärnlund, U., Lindström, M., Elfving, T., and Sundelin, B. **Single and combined effects of hypoxia and contaminated sediments on the amphipod *Monoporeia affinis* in laboratory toxicity bioassays based on multiple biomarkers.** *Aquatic Toxicology* 99(2): 263-274, 2010.

Notes: In estuaries, hypoxic conditions and pollution are among the major factors responsible for the declines in habitat quality, yet little is known about their combined effects on estuarine organisms. In this study, to investigate single and combined effects of hypoxia and contaminated sediment, the Baltic amphipod *Monoporeia affinis* was exposed for 5-9 days to four different combinations of oxygen conditions (moderate hypoxia vs. normoxia) and contamination (polluted vs. unpolluted sediments) at environmentally realistic levels. To detect oxidative stress, a suite of biomarkers was used - antioxidant enzymes [superoxide dismutases (SOD), catalase (CAT), and glutathione S-transferases (GST)], acetylcholinesterase (AChE), lipid peroxidation status (TBARS concentration), protein carbonyl content (PCC), and DNA strand breakage (DNA-SB). To assay effects at the organism level, we used RNA:DNA ratio as a proxy for growth and metabolic rate and mortality. There were significant increases in CAT and SOD activities and TBARS levels in response to both moderate hypoxia and contaminated sediment, while GST increased and AChE decreased in response to the contamination only. Significant positive correlations were observed among the antioxidant enzymes and between the enzyme activities and TBARS concentration, suggesting a complex response to the oxidative stress. No significant changes in PCC were recorded in any of the treatments. Furthermore, the negative effect of hypoxia on DNA integrity was significant; with frequency of DNA-SB increasing in animals exposed to hypoxia in contaminated sediment. Despite clear effect at the cellular and biochemical levels, no responses at the organism level were observed. Multivariate analyses of the dataset have allowed us to link exposure factors to individual biomarker responses. Of the potential biomarkers assessed in this study, CAT activity was found to be associated with hypoxia, while SOD, GST and AChE activities appear to predict best the effects of exposure to sediments containing several contaminants (e.g. heavy metals, PCBs and PAHs), and TBARS concentration is particularly indicative of combined effects of hypoxia and contamination. In addition to providing new knowledge on the combined effects of multiple stressors on estuarine organisms, the findings of the present study are also important to understand data from biomonitoring studies in the Baltic Sea and in other regions where multiple stress factors co-occur.

Lewis, C., Guitart, C., Pook, C., Scarlett, A., Readman, J.W., and Galloway, T.S. **Integrated assessment of oil pollution using biological monitoring and chemical fingerprinting.** *Environmental Toxicology and Chemistry* 29(6): 1358-1366, 2010.

Notes: A full assessment of the impact of oil and chemical spills at sea requires the identification of both the polluting chemicals and the biological effects they cause. Here, a combination of chemical fingerprinting of surface oils, tissue residue analysis, and biological effects measures was used to explore the relationship between spilled oil and biological impact following the grounding of the **MSC Napoli** container ship in Lyme Bay, England in January 2007. Initially, oil contamination remained restricted to a surface slick in the vicinity of the wreck, and there was no chemical evidence to link biological impairment of animals (the common limpet, **Patella niigata**) on the shore adjacent to the oil spill. Secondary oil contamination associated with salvage activities in July 2007 was also assessed. Chemical analyses of aliphatic hydrocarbons and terpanes in shell swabs taken from limpet shells provided an unequivocal match with the fuel oil carried by the ship. Corresponding chemical analysis of limpet tissues revealed increased concentrations of polycyclic aromatic hydrocarbons (PAHs) dominated by phenanthrene and C1 to C3 phenanthrenes with smaller contributions from heavier molecular weight PAHs. Concurrent ecotoxicological tests indicated impairment of cellular viability ($p < 0.001$), reduced immune function ($p < 0.001$), and damage to DNA (Comet assay, $p < 0.001$) in these animals, whereas antioxidant defenses were elevated relative to un-oiled animals. These results illustrate the value of combining biological monitoring with chemical fingerprinting for the rapid identification of spilled oils and their sublethal impacts on biota in situ.

Álvarez-Muñoz, D., Gómez-Parra, A., and González-Mazo, E. **Influence of the molecular structure and exposure concentration on the uptake and elimination kinetics, bioconcentration, and biotransformation of anionic and nonionic surfactants.** *Environmental Toxicology and Chemistry* 29(8): 1727-1734, 2010.

Notes: In vivo experiments with fish (sole) were performed for pure homologs of linear alkylbenzene sulfonates (LAS) and alcohol ethoxylates (AEO), the most widely used anionic and nonionic surfactants. The surfactant concentration measured in the organism was higher than in the experimental water, and increased with the exposure concentration for both compounds. At the exposure levels tested the bioconcentration factors (BCF) for AEO were one order of magnitude higher than for LAS. Two linear relationships for hydrophobicity were established, one with BCF and the other with uptake rate. The influence of the exposure concentration on the uptake (k_1) and elimination (k_2) velocities was researched. The value obtained for k_1 for AEO was higher than for LAS, while k_2 was very similar for both compounds, indicating differences in the incorporation and but not in the depuration rate. For the first time, internal degradation products of LAS were identified and quantified in fish and water and the glucuronic conjugate of AEO was detected in an organism. The predominant biotransformation process for these compounds may be different: the results suggest a phase I biotransformation for LAS and phase II for AEO, due to their different molecular structures.

Bustnes, J.O., Gabrielsen, G.W., and Verreault, J. **Climate variability and temporal trends of persistent organic pollutants in the Arctic: A study of glaucous gulls.** *Environmental Science and Technology* 44(8): 3155-3161, 2010.

Notes: The impact of climate variability on temporal trends (1997-2006) of persistent organic pollutants (POPs; polychlorinated biphenyls [PCB], hexachlorobenzene [HCB], and oxychlorodane) was assessed in glaucous gulls (**Carus hyperboreus**) breeding in the Norwegian Arctic ($n = 240$). The Arctic Oscillation (AO: an index of sea-level pressure variability in the Northern Hemisphere above 20 °N) with different time lags was used as a climate proxy. The estimated concentrations of POPs in glaucous gull blood/plasma declined substantially (16-60%) over the time period. Multiple regression analyses showed that the rates of decline for POPs were correlated to climate variation when controlling for potential confounding variables (sex and body condition). More specifically AO in the current winter showed negative associations with POP concentrations, whereas the relationships with AO measurements from the year preceding POP measurements (AO preceding summer and AO preceding winter) were positive. Hence, gulls had relatively higher POP concentrations in breeding seasons following years with high air transport toward the Arctic. Furthermore, the impact of AO appeared to be stronger for HCB, a relatively volatile compound with high transport potential, compared to heavy chlorinated PCB congeners. This study thus suggests that predicted climate change should be considered in assessments of future temporal trends of POPs in Arctic wildlife.

Law, R.J., Barry, J., Bersuder, P., Barber, J.L., Deaville, R., Reid, R.J., and Jepson, P.D. **Levels and trends of brominated diphenyl ethers in blubber of harbor porpoises (*Phocoena phocoena*) from the UK, 1992-2008.** *Environmental Science and Technology* 44(12): 4447-4451, 2010.

Notes: Controls were placed on the production and use of the penta-mix polybrominated diphenyl ether (PBDE) formulation within the European Union in 2004. In porpoises stranded or bycaught around the U.K., BDE congeners from this product predominate. Lipid-normalized concentrations of 9 (summed) BDE congeners in the blubber of 415 porpoises sampled during the period 1992-2008 have been investigated for possible time trends resulting from the regulatory action. Our analysis suggests that, overall, median Σ 9BDE concentrations peaked around 1998 and have since reduced by between 53.8% and 73.5% to 2008. Our best point estimate is that the reduction has been 67.6%. This decline was highly statistically significant ($p < 0.001$) and was not confounded by a range of other factors which were also considered (area, season, nutritional status, bycaught/stranded, and age class).

Judson, R.S., Martin, M.T., Reif, D.M., Houck, K.A., Knudsen, T.B., Rotroff, D.M., Xia, M.H., Sakamuru, S., Huang, R.L., Shinn, P., Austin, C.P., Kavlock, R.J., and Dix, D.J. **Analysis of eight oil spill dispersants using rapid, in vitro tests for endocrine and other biological activity.** *Environmental Science and Technology* 44(15): 5979-5985, 2010.

Notes: The **Deepwater Horizon** oil spill has led to the use of >1 M gallons of oil spill dispersants, which are mixtures of surfactants and solvents. Because of this large scale use there is a critical need to understand the potential for toxicity of the currently used dispersant and potential alternatives, especially given the limited toxicity testing information that is available. In particular, some dispersants contain nonylphenol ethoxylates (NPEs), which can degrade to nonylphenol (NP), a known endocrine disruptor. Given the urgent need to generate toxicity data, we carried out a series of in vitro high-throughput assays on eight commercial dispersants. These assays focused on the estrogen and androgen receptors (ER and AR), but also included a larger battery of assays probing other biological pathways. Cytotoxicity in mammalian cells was also quantified. No activity was seen in any AR assay. Two dispersants showed a weak ER signal in one assay (EC50 of 16 ppm for Nokomis 3-F4 and 25 ppm for ZI-400). NPs and NPEs also had a weak signal in this same ER assay. Note that Corexit 9500, the currently used product, does not contain NPEs and did not show any ER activity. Cytotoxicity values for six of the dispersants were statistically indistinguishable, with median LC50 values similar to 100 ppm. Two dispersants, JD 2000 and SAF-RON GOLD, were significantly less cytotoxic than the others with LC50 values approaching or exceeding 1000 ppm.

Rauch, J.N. **Global spatial indexing of the human impact on Al, Cu, Fe, and Zn mobilization.** *Environmental Science and Technology* 44(15): 5728-5734, 2010.

Notes: With increasing consumption of material by human activity, the extent of human influence relative to nature in the mobilization of metals and other elements on Earth continues to grow. Recognizing people as modern geomorphic agents, I produced global data layers at $1^\circ \times 1^\circ$ of human-mediated mass flows (coal combustion, biomass burning, and mining) and nature-mediated mass flows (net primary productivity, sea salt aerosol emission, and denudation to the oceans) for the industrial metals of aluminum, iron, copper, and zinc for the year 2000. The major mobilization processes are denudation (natural) and mining (anthropic), though net primary productivity for Zn and Cu and coal combustion for Al are nearly as significant. All flows are subsequently combined into an index representing human versus nature flow dominance. As the first maps of mobilization flows of metals widely used by modern technology, they reveal that ~1-5% (depending upon the metal) of Earth's land surface now has metal flow dominated by human activity.

Liu, Y., Evans, M.A., and Scavia, D. **Gulf of Mexico hypoxia: Exploring increasing sensitivity to nitrogen loads.** *Environmental Science and Technology* 44(15): 5836-5841, 2010.

Notes: Hypoxia is a critical issue in the Gulf of Mexico that has challenged management efforts in recent years by an increase in hypoxia sensitivity to nitrogen loads. Several mechanisms have been proposed to explain the recent increase in sensitivity. Two commonly cited mechanisms are bottom-water reducing conditions preventing nitrification and thus denitrification, leading to more N recycling and production of oxygen-consuming organic matter, and carryover of organic matter from

previous years increasing oxygen demand, making the system more sensitive. We use models informed by these mechanisms and fit with Bayesian inference to explore changes in Gulf of Mexico hypoxia sensitivity. We show that a model including an annually fit parameter representing variation in the fraction of nutrient loading and recycling contributing to bottom water oxygen demand provides a good fit to observations and is not improved by explicit inclusion of organic matter carryover to subsequent years. Both models support two stepwise increases in system sensitivity during the period of record. This change in sensitivity has greatly increased the nutrient reduction needed to achieve the established hypoxia goal. If the Gulf remains at the current state of sensitivity, our analysis suggests a roughly 70% reduction of spring TN loads from the 1988-1996 average of 6083 ton/day may be required.

Tourinho, P.S., do Sul, J.A.I., and Fillrann, G. **Is marine debris ingestion still a problem for the coastal marine biota of southern Brazil?** *Marine Pollution Bulletin* 60(3): 396-401, 2010.

Notes: The accumulation of synthetic debris in marine and coastal environments is a consequence of the intensive and continuous release of these highly persistent materials. This study investigates the current status of marine debris ingestion by sea turtles and seabirds found along the southern Brazilian coast. All green turtles ($n = 34$) and 40% of the seabirds (14 of 35) were found to have ingested debris. No correlation was found between the number of ingested items and turtle's size or weight. Most items were found in the intestine. Plastic was the main ingested material. Twelve Procellariiformes (66%), two Sphenisciformes (22%), but none of the eight Charadriiformes were found to be contaminated. Procellariiformes ingested the majority of items. Plastic was also the main ingested material. The ingestion of debris by turtles is probably an increasing problem on southern Brazilian coast. Seabirds feeding by diverse methods are contaminated, highlighting plastic hazard to these biota.

Law, R.J., Bersuder, P., Barry, J., Deaville, R., Reid, R.J., and Jepson, P.D. **Chlorobiphenyls in the blubber of harbour porpoises (*Phocoena phocoena*) from the UK: Levels and trends 1991-2005.** *Marine Pollution Bulletin* 60(3): 470-473, 2010.

Notes: Harbour porpoises sampled within the UK Cetacean Strandings Investigation Programme have been analysed for 25 chlorobiphenyl congeners. In all, 440 porpoises stranded or bycaught during the period 1991-2005 were studied. There are regional differences in the trend in summed congener concentrations over time but, despite controls on PCBs having been in place for decades, they are declining only slowly. Their toxic impacts in UK porpoises – increased susceptibility to infectious disease mortality in the most contaminated individuals – looks likely to continue for some time yet. Further efforts to limit or eliminate PCB discharges to the marine environment are still needed.

Colabuono, F.I., Taniguchi, S., and Montone, R.C. **Polychlorinated biphenyls and organochlorine pesticides in plastics ingested by seabirds.** *Marine Pollution Bulletin* 60(4): 630-634, 2010.

Notes: The occurrence of plastic objects in the digestive tract was assessed in eight species of Procellariiformes collected in southern Brazil and the occurrence of polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the ingested plastics pellets and plastic fragments was evaluated. PCBs were detected in plastic pellets (491 ng g⁻¹) and plastic fragments (243-418 ng g⁻¹). Among the OCPs, *p,p'*-DDE had the highest concentrations, ranging from 68.0 to 99.0 ng g⁻¹. The occurrence of organic pollutants in post-consumer plastics supports the fact that plastics are an important source carrying persistent organic pollutants in the marine environment. Although transfer through the food chain may be the main source of exposure to POPs to seabirds, plastics could be an additional source for the organisms which ingest them, like Procellariiformes which are the seabirds most affected by plastic pollution.

Cooper, D. A. and Corcoran, P.L. **Effects of mechanical and chemical processes on the degradation of plastic beach debris on the island of Kauai, Hawaii.** *Marine Pollution Bulletin* 60(5): 650-654, 2010.

Notes: Plastic debris is accumulating on the beaches of Kauai at an alarming rate, averaging 484 pieces/day in one locality. Particles sampled were analyzed to determine the effects of mechanical and chemical processes on the breakdown of polymers in a subtropical setting. Scanning electron microscopy (SEM) indicates that plastic surfaces contain fractures, horizontal notches, flakes, pits, grooves, and vermiculate textures. The mechanically produced textures provide ideal loci for chemical weathering to occur which further weakens the polymer surface leading to embrittlement. Fourier transform infrared spectroscopy (FTIR) results show that some particles have highly oxidized surfaces as indicated by intense peaks in the lower wavenumber region of the spectra. Our textural analyses suggest that polyethylene has the potential to degrade more readily than polypropylene. Further evaluation of plastic degradation in the natural environment may lead to a shift away from the production and use of plastic materials with longer residence times.

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 cm² to about 16 m². 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.

Keller, A.A., Fruh, E.L., Johnson, M.M., Simon, V., and McGourty, C. **Distribution and abundance of anthropogenic marine debris along the shelf and slope of the US West Coast.** *Marine Pollution Bulletin* 60(5): 692-700, 2010.

Notes: As marine debris levels continue to grow worldwide, defining sources, composition, and distribution of debris, as well as potential effects, becomes increasingly important. We investigated composition and abundance of man-made, benthic marine debris at 1347 randomly selected stations along the US West Coast during Groundfish Bottom Trawl Surveys in 2007 and 2008. Anthropogenic debris was observed in 469 tows at depths of 55-1280 m. Plastic and metallic debris occurred in the greatest number of hauls followed by fabric and glass. Mean density was 67.1 items km⁻² throughout the study area but was significantly higher south of 36°00'N latitude. Mean density significantly increased with depth, ranging from 30 items km⁻² in shallow (55-183 m) water to 128 items km⁻² in the deepest depth stratum (550-1280 m). Debris densities observed along the US West Coast were comparable to those seen elsewhere and provide a valuable backdrop for future comparisons.

Kirby, M.F. and Law, R.J. **Accidental spills at sea – Risk, impact, mitigation and the need for co-ordinated post-incident monitoring.** *Marine Pollution Bulletin* 60(6): 797-803, 2010.

Notes: A fully integrated and effective response to an oil or chemical spill at sea must include a well planned and executed post-incident assessment of environmental contamination and damage. While salvage, rescue and clean-up operations are generally well considered, including reviews and exercises, the expertise, resources, networks and logistical planning required to achieve prompt and effective post-spill impact assessment and monitoring are not generally well established. The arrangement and co-ordination of post-incident monitoring and impact assessment need to consider sampling design, biological effects, chemical analysis and collection/interpretation of expert local knowledge. This paper discusses the risks, impacts and mitigation options associated with accidental spills and considers the importance of pre-considered impact assessment and monitoring programmes in the wider response cycle. The PREMIAM (Pollution Response in Emergencies: Marine Impact Assessment and Monitoring: www.premiam.org) project is considered as an example of an improved approach to the planning, co-ordination and conduct of post-incident monitoring.

Ribic, C.A., Sheavly, S.B., Rugg, D.J., and Erdmann, E.S. **Trends and drivers of marine debris on the Atlantic coast of the United States 1997-2007.** *Marine Pollution Bulletin* 60(8): 1231-1242, 2010.

Notes: For the first time, we documented regional differences in amounts and long-term trends of marine debris along the US Atlantic coast. The Southeast Atlantic had low land-based and general-source debris loads as well as no increases despite a 19% increase in coastal population. The Northeast (8% population increase) also had low land-based and general-source debris loads and no increases. The Mid-Atlantic (10% population increase) fared the worst, with heavy land-based and general-source debris loads that increased over time. Ocean-based debris did not change in the Northeast where the fishery is relatively stable; it declined over the Mid-Atlantic and Southeast and was correlated with declining regional fisheries. Drivers, including human population, land use status, fishing activity, and oceanic current systems, had complex relationships with debris loads at local and regional scales. Management challenges remain undeniably large but solid information from long-term programs is one key to addressing this pressing pollution issue.

Bond, A.L., Jones, I.L., Williams, J.C., and Byrd, G.V. **Auklet (Charadriiformes: Alcidae, *Aethia* spp.) chick meals from the Aleutian Islands, Alaska, have a very low incidence of plastic marine debris.** *Marine Pollution Bulletin* 60(8): 1346-1349, 2010.

Notes: The ingestion of plastic marine debris is a chronic problem for some of the world's seabird species, contributing to reduced chick survival, population declines, and deposition of contaminants via absorption in birds' gastrointestinal tract. We analysed the frequency of ingested plastic in chick meals delivered by adults in four species of auklet – Crested (*Aethia cristatella*), Least (*A. pusilla*), Parakeet (*A. psittacula*), and Whiskered (*A. pygmaea*) – from three breeding colonies in the Aleutian Islands, Alaska, USA over a 14-year period from 1993 to 2006. Among 2541 chick meals, we found plastic in only one – from a Whiskered Auklet on Buldir Island in 1993. While adult Parakeet Auklets have a high frequency of plastic ingestion (over 90%), no chick meals contained plastic. Unlike other seabirds, the planktivorous auklets do not appear to offload plastic to their chicks, and we conclude that auklet chicks are probably at a low risk of contamination from plastic debris.

Provencher, J.F., Gaston, A.J., Mallory, M.L., O'Hara, P.D., and Gilchrist, H.G. **Ingested plastic in a diving seabird, the thick-billed murre (*Uria lomvia*), in the eastern Canadian Arctic.** *Marine Pollution Bulletin* 60(9): 1406-1411, 2010.

Notes: Plastic debris has become ubiquitous in the marine environment and seabirds may ingest debris which can have deleterious effects on their health. In the North Atlantic Ocean, surface feeding seabirds typically ingest high levels of plastic, while the diving auks which feed in the water column typically have much lower levels. We examined 186 thick-billed murre from five colonies in the eastern Canadian Arctic for ingested plastic debris. Approximately 11% of the birds had at least one piece of plastic debris in their gastrointestinal tracts, with debris dominated by user plastics. This is the first report of ingested plastics in an auk species in Canada's Arctic, and the highest incidence of plastic ingestion to date for thick-billed murre (*Uria lomvia*).

Barco, S.G., D'Eri, L.R., Woodward, B.L., Winn, J.P., and Rotstein, D.S. **Spectra® fishing twine entanglement of a bottlenose dolphin: A case study and experimental modeling.** *Marine Pollution Bulletin* 60(9): 1477-1481, 2010.

Notes: We report here the first documented case of a cetacean fatality from entanglement in recreational Spectra® fishing twine. Spectra® twine is a relatively new microfilament braided twine that is marketed to replace nylon monofilament twine in rod and reel fisheries. Following the case of this entangled bottlenose dolphin (*Tursiops truncatus*), we conducted tests with Spectra® and comparable monofilament twines on *Tursiops* tissue from stranded animals to compare the abrasion properties of the twines. We found that Spectra® twine was significantly more abrasive on bottlenose dolphin fluke tissue than a similar strength and diameter monofilament. With the same forces applied, the Spectra® twine cut deeper than the monofilament, exhibiting a linear relationship with force applied where the monofilament appeared to reach a maximum depth of penetration

of approximately 2 mm. These tests may explain why this bottlenose dolphin was so severely debilitated from carrying a relatively light load of twine over a short period of time (20 days). Future public and corporate outreach will be essential to minimize the effect that this increasingly popular fishing twine will have on non-target species.

Jung, R.T., Sung, H.G., Chun, T.B., and Keel, S.I. **Practical engineering approaches and infrastructure to address the problem of marine debris in Korea.** *Marine Pollution Bulletin* 60(9): 1523-1532, 2010.

Notes: As a solution to the problem of persistent solid marine debris, a nationwide project began in Korea in 1999 to develop and popularize fundamental changes to the infrastructure. The ten year project, called "A Practical Integrated System for Marine Debris," consists of four linked types of technology: prevention, deep-water survey, removal and treatment (recycling). These reflect the characteristics of marine debris, which though widespread, vary by location and time of generation. Each technical component has each representative outcome that has been outreached to the local governments and marine debris-related associations. The in situ infrastructures lead to enhance the retrieval of the marine debris and create direct and indirect benefits to industry. Both end-of-pipe technology improvement and the introduction of front-of-pipe technology should be considered as we strive to reduce the generation of marine debris in Korean coastal areas.
