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Pollution

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In this review:

A. Recent articles – no abstract available

Yamashita, R. and Tanimura, A. **Floating plastic in the Kuroshio Current area, western North Pacific Ocean.** *Marine Pollution Bulletin* 54(4): 485-488, 2007.

Garrison, V.H. and et al. **Saharan dust - a carrier of persistent organic pollutants, metals, and microbes to the Caribbean?** *Revista de Biología Tropical* 54(Suppl. 3): 9-21, 2006.

B. Recent articles with abstracts

Perrez, F.X. **The strategic approach to international chemicals management: Lost opportunity or foundation for a brave new world?** *Review of European Community and International Environmental Law* 15(3): 245-257, 2006.

Notes: Numerous international instruments have been developed to promote sustainable chemicals management. However, until recently, a common overarching framework for sustainable chemicals policy was missing. The Strategic Approach to International Chemicals Management (SAICM) was developed to address this challenge. This article will provide a short overview of the context and the negotiation process of SAICM, and it will give a short summary and assessment of its content. The article will conclude that SAICM is neither a lost opportunity nor the foundation of a brave new world of chemicals policy, but that it establishes a comprehensive institutional framework that can be further developed into an effective instrument of international chemicals policy.

Langston, W.J., Burt, G.R., and Chesman, B.S. **Feminisation of male clams *Scrobicularia plana* from estuaries in Southwest UK and its induction by endocrine-disrupting chemicals.** *Marine Ecology Progress Series* 333: 173-184, 2007.

Notes: The risk of endocrine disruption in the marine environment is unclear and is often overlooked in invertebrates. We show that disruption to the 'normal' gonadal development of male estuarine clams *Scrobicularia plana* is occurring extensively at sites in Southwest UK, with populations exhibiting varying degrees of intersex (ovotestis). This is one of the few studies to have examined the extent of the condition in mollusc populations. Intersex was present in more than two-thirds of the populations screened from the Avon, Southampton Water, Bristol Channel/Severn, Erme, Plym, Fal, Tamar and Lynher Estuaries; severity varied, with between 0 and 60% of males exhibiting the condition. Prevalence of intersex tended to peak as gonads reached maturity in July, and was highest in clams from the Bristol Channel and Severn Estuary, coinciding with an increase in oocyte size in both the female gonad and in the ovotestis of affected males. Experimental exposures to sediment spiked with mixtures of 17 β-oestradiol (E2), 17 α-ethinyloestradiol (EE2), octylphenol (OP) and nonylphenol (NP) indicated that (xeno)estrogens could be a contributory factor in the induction of intersex and increased oocyte size. It is plausible, therefore, that the incidence of ovotestis may be linked to urban, industrial and agricultural influences, or a combination thereof, although the relative importance of these sources has yet to be determined. *S. plana* offers potential as a sentinel

species for screening and investigation of endocrine disruption in the estuarine environment, helping to focus remediatory strategy where it would be most beneficial.

Rodriguez, E.M., Medesani, D.A., and Fingerman, M. **Endocrine disruption in crustaceans due to pollutants: A review.** *Comparative Biochemistry and Physiology -- Part A* 146(4): 661-671, 2007.

Notes: The main endocrine-regulated processes of crustaceans have been reviewed in relation to the effects of endocrine-disrupting compounds (EDCs). Molting has been shown to be inhibited by several organic pollutants, such as xenoestrogens and related compounds, as well as by some pesticides. Most of these disrupters are thought to interfere with ecdysone at target tissues, although only for a few has this action been demonstrated in vitro. The heavy metal cadmium appears to inhibit some ecdysone secretion. Juvenoid compounds have also been shown to inhibit molting, likely by interfering with the stimulatory effect of methyl famesoate. A molt-promoting effect of emamectin benzoate, a pesticide, has also been reported. As for reproduction, a variety of organic compounds, including xenoestrogens, juvenoids and ecdysteroids, has produced abnormal development of male and female secondary sexual characters, as well as alteration of the sex ratio. Cadmium and copper have been shown to interfere with hormones that stimulate reproduction, such as methyl fameaoate, as well as with secretion of the gonad inhibiting hormone, therefore affecting, for example, ovarian growth. Several heavy metals were able to produce hyperglycemia in crustaceans during short times of exposure; while a hypoglycemic response was noted after longer exposures, due to inhibition of secretion of the crustacean hyperglycemic hormone. The ecological relevance of EDCs on crustaceans is discussed, mainly in relation to the identification of useful biomarkers and sentinel species. New experimental approaches are also proposed.

Cai, Y., Rooker, J.R., Gill, G.A., and Turner, J.P. **Bioaccumulation of mercury in pelagic fishes from the northern Gulf of Mexico.** *Canadian Journal of Fisheries and Aquatic Sciences* 64(3): 458-469, 2007.

Notes: Total mercury (Hg) concentration was determined in the tissues of 10 pelagic fishes in the northern Gulf of Mexico, and dietary tracers (stable isotopes and fatty acids) were used to evaluate the relationship between Hg and feeding history. Highest Hg levels were observed in blue marlin (*Makaira nigricans*), carcharhinid sharks (*Carcha rhinus* spp.), and little tunny (*Euthynnus alletteratus*), ranging from 1.08 to 10.52 ppm. Moderate to low concentrations (< 1.0 ppm) were observed in blackfin tuna (*Thunnus atlanticus*), cobia (*Rachycentron canadum*), dolphinfish (*Coryphaena hippurus*), greater amberjack (*Seriola dumerili*), king mackerel (*Scomberomorus cavalla*), wahoo (*Acanthocybium solandri*), and yellowfin tuna (*Thunnus albacares*). For the majority of species examined, Hg concentrations did not vary significantly between location (Texas vs. Louisiana) or collection period (2002 and 2003). Significant positive relationships between Hg concentration and body size and (or) weight were detected for 6 of the 10 taxa examined. Hg concentration was also positively associated with trophic position. Three natural associations were identified using stable isotope and fatty acid signatures. Still, no connection between these natural trophic associations and Hg concentration was observed, suggesting that Hg concentration in pelagic fishes was more closely linked to trophic position and size than feeding history.

Schenker, U., Scheringer, M., and Hungerbuhler, K. **Including degradation products of persistent organic pollutants in a global multi-media box model.** *Environmental Science and Pollution Research* 14(3): 145-152, 2007.

Notes: *Goal, Scope and Background.* Global multi-media box models are used to calculate the fate of persistent organic chemicals in a global environment and assess long-range transport or arctic contamination. Currently, such models assume substances to degrade in one single step. In reality, however, intermediate degradation products are formed. If those degradation products have a high persistence, bioaccumulation potential and/or toxicity, they should be included in environmental fate models. The goal of this project was to gain an overview of the general importance of degradation products for environmental fate models, and to expand existing, exposure-based hazard indicators to take degradation products into account. *Methods.* The environmental fate model CliMoChem was modified to simultaneously calculate a parent compound and several degradation products. The three established hazard indicators of persistence, spatial range and arctic contamination potential were extended to include degradation products. Five well-known pesticides were selected as example chemicals. For those substances, degradation pathways were calculated with CATABOL, and partition coefficients and half-lives were compiled from literature. *Results.* Including degradation products yields a joint persistence value that is significantly higher than the

persistence of the parent compound alone: in the case of heptachlor an increase of the persistence by a factor of 58 can be observed. For other substances, the increase is much smaller (4% for α-HCH). The spatial range and the arctic contamination potential (ACP) can increase significantly, too: for 2,4-D and heptachlor, an increase by a factor of 2.4 and 3.5 is seen for the spatial range. However, an important increase of the persistence does not always lead to a corresponding increase in the spatial range: the spatial range of aldrin increases by less than 50%, although the persistence increases by a factor of 20 if the degradation products are included in the assessment. Finally, the arctic contamination potential can increase by a factor of more than 100 in some cases. *Discussion*. Influences of parent compounds and degradation products on persistence, spatial range and ACP are discussed. Joint persistence and joint ACP reflect similar characteristics of the total environmental exposure of a substance family (i.e., parent compound and all its degradation products). *Conclusions*. The present work emphasizes the importance of degradation products for exposure-based hazard indicators. It shows that the hazard of some substances is underestimated if the degradation products of these substances are not included in the assessment. The selected hazard indicators are useful to assess the importance of degradation products. *Recommendations and Perspectives*. It is suggested that degradation products be included in hazard assessments to gain a more accurate insight into the environmental hazard of chemicals. The findings of this project could also be combined with information on the toxicity of degradation products. This would provide further insight into the importance of degradation products for environmental risk assessments.

Evans, A.D. and Nipper, M. **Toxicity of phenanthrene and lindane mixtures to marine invertebrates.** *Environmental Toxicology* 22: 495-501, 2007.

Notes: Surface waters near industrialized and agricultural areas are contaminated with hundreds of different pollutants from a variety of sources. Methods for measurement of sediment, surface water, and porewater toxicity in marine environments include the sea urchin (*Arbacia punctulata*) fertilization and embryological development tests and copepod (*Schizopera knabeni*) survival and hatching success assessment. The concentration addition model was applied to determine whether toxicity of two compounds, phenanthrene (polycyclic aromatic hydrocarbon) and lindane (organochlorine pesticide), when combined can be accurately assessed because of similar modes of action. Mixture analysis determined the sea urchin fertilization test to exhibit additivity (TUmix = 1.13), while the copepod test exhibited a synergistic effect (TUmix = 0.22). Mixture toxicity data for the sea urchin embryological test were not conclusive because of the lack of toxicity of the individual chemicals. The synergistic effect to copepods is a concern as it indicates that greater toxic effects may occur when the compounds are present in mixtures. Results from this research suggest that increased toxicity to some categories of organisms should be expected near agricultural and industrial areas where pesticides and other types of compounds may occur simultaneously.

Greig, T.W., Bemiss, J.A., Lyon, B.R., Bossart, G.D., and Fair, P.A. **Prevalence and diversity of antibiotic resistant *Escherichia coli* found in bottlenose dolphins (*Tursiops truncatus*) from the Indian River Lagoon, Florida, and Charleston Harbor area, South Carolina.** *Aquatic Mammals* 33(2): 185-194, 2007.

Notes: A total of 724 *Escherichia coli* isolates sampled from 38 wild bottlenose dolphins (*Tursiops truncatus*) from the Charleston Harbor area, South Carolina, and the Indian River Lagoon, Florida, were screened for resistance to 25 antibiotics. The percentages of animals harboring at least one resistant isolate differed significantly between sampling locations. No resistance was detected in *E. coli* from dolphins at either site for six of the 25 antibiotics tested. Resistance to penicillin was most common followed by cephalothin, ampicillin, and amoxicillin. Within-animal isolate variability was examined in addition to between sampling locales. Isolates from animals sampled in the Charleston Harbor area exhibited a greater complexity of resistance patterns and within individual diversity compared to isolates sampled from animals in the Indian River Lagoon. Causes related to the observed heterogeneity are discussed.

Korpinen, S., Honkanen, T., Vesakoski, O., Hemmi, A., Koivikko, R., Loponen, J., and Jormalainen, V. **Macroalgal communities face the challenge of changing biotic interactions: Review with focus on the Baltic Sea.** *Ambio* 36(2-3): 203-211, 2007.

Notes: In diverse littoral communities, biotic interactions play an important role in community regulation. This article reviews how eutrophication modifies biotic interactions in littoral macroalgal communities. Eutrophication causes blooms of opportunistic algae, increases epibiotism, and affects regulation by grazers. Opportunistic algae and epibionts harm

colonization and growth of perennial algae. Grazing regulates the density and species composition of macroalgal communities, especially at the early stage of algal colonization. Eutrophication supports higher grazer densities by increasing the availability and quality of algae to grazers. This may, on the one hand, enhance the capability of grazers to regulate and counteract the increase of harmful, bloom-forming macroalgae; on the other hand, it may increase grazing pressure on perennial species, with a poor tolerance of grazing. In highly eutrophic conditions, bloom-forming algae may also escape grazing control and accumulate. Increasing epibiotism and grazing threaten in particular the persistence of habitat-forming perennials such as the bladderwrack. An interesting property of biotic interactions is that they do not remain fixed but are able to evolve, as the traits of the interacting species adapt to each other and to abiotic conditions. The potential of plants and grazers to adapt is crucial to their chances to survive in changing environment.

Breivik, K., Sweetman, A., Pacyna, J.M., and Jones, K.C. **Towards a global historical emission inventory for selected PCB congeners - A mass balance approach. 3. An update.** *The Science of the Total Environment* 377(2-3): 296-307, 2007.

Notes: Previously published estimates of the global production, consumption and atmospheric emissions of 22 individual PCB congeners [Breivik K, Sweetman A, Pacyna JM, Jones KC. Towards a global historical emission inventory for selected PCB congeners - a mass balance approach. 1. Global production and consumption. Sci Total Environ 2002a; 290: 181-198.; Breivik K, Sweetman A, Pacyna JM, Jones KC. Towards a global historical emission inventory for selected PCB congeners - a mass balance approach. 2. Emissions. Sci Total Environ 2002b; 290: 199-224.] have provided useful information for later studies attempting to interpret contaminant levels in remote areas as well as in the global environment. As a result of the need for more contemporary emission data (following the year 2000), an update of this emission database is presented. This exercise takes into account new information on PCB production in Poland, as well as new data on the chemical composition of various technical mixtures for which less information had been available. The methodology to estimate temporal trends of PCB emissions associated with various types of PCB usage is improved. Projected emissions up to year 2100 are presented to facilitate predictions of future environmental exposure. The national emission data for each of the 114 countries considered is spatially resolved on a 1° x 1° grid for each congener and year, using population density as a surrogate.

Eckhardt, S., Breivik, K., Manø, S., and Stohl, A. **Record high peaks in PCB concentrations in the Arctic atmosphere due to long-range transport of biomass burning emissions.** *Atmospheric Chemistry and Physics Discussions* 7: 6229-6254, 2007.

Notes: Soils and forests in the boreal region of the northern hemisphere are recognised as having a large capacity for storing air-borne Persistent Organic Pollutants (POPs), such as the polychlorinated biphenyls (PCBs). Following reductions of primary emissions of various legacy POPs, there is an increasing interest and debate about the relative importance of secondary re-emissions on the atmospheric levels of POPs. In spring of 2006, biomass burning emissions from agricultural fires in Eastern Europe were transported to the Zeppelin station on Svalbard, where record-high levels of many air pollutants were recorded. Here we report on the extremely high concentrations of PCBs that were also measured during this period. 21 out of 32 PCB congeners were enhanced by more than two standard deviations above the long-term mean concentrations. In July 2004, about 5.8 million hectare of boreal forest burned in North America, emitting a pollution plume which reached the Zeppelin station after a travel time of 3-4 weeks. Again, 12 PCB congeners were elevated above the long-term mean by more than two standard deviations, with the less chlorinated congeners being most strongly affected. We propose that these abnormally high concentrations were caused by biomass burning emissions. Based on enhancement ratios with carbon monoxide and known emissions factors for this species, we estimate that 130 and 66 μg PCBs were released per kilogram dry matter burned, respectively. To our knowledge, this is the first study relating atmospheric PCB enhancements with biomass burning. The strong effects on observed concentrations far away from the sources, suggest that biomass burning is an important source of PCBs for the atmosphere.

Haukas, M., Berger, U., Hop, H., Gulliksen, B., and Gabrielsen, G.W. **Bioaccumulation of per- and polyfluorinated alkyl substances (PFAS) in selected species from the Barents Sea food web.** *Environmental Pollution* 148(1): 360-371, 2007.

Notes: The present study reports concentrations and biomagnification potential of per- and polyfluorinated alkyl substances (PFAS) in species from the Barents Sea food web. The examined species included sea ice amphipod (*Gammarus wilkitzkii*), polar cod (*Boreogadus saida*), black guillemot (*Cepphus grylle*) and glaucous gull (*Larus hyperboreus*). These were analyzed for PFAS,

polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethanes (DDTs) and polybrominated diphenyl ethers (PBDEs). Perfluorooctane sulfonate (PFOS) was the predominant of the detected PFAS. Trophic levels and food web transfer of PFAS were determined using stable nitrogen isotopes ($\delta^{15}N$). No correlation was found between PFOS concentrations and trophic level within species. However, a non-linear relationship was established when the entire food web was analyzed. Biomagnification factors displayed values >1 for perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), PFOS and ΣPFAS(7). Multivariate analyses showed that the degree of trophic transfer of PFAS is similar to that of PCB, DDT and PBDE, despite their accumulation through different pathways.

Sonne, C., Fonfara, S., Dietz, R., Kirkegaard, M., Letcher, R.J., Shahmiri, S., Andersen, S., and Moller, P. **Multiple cytokine and acute-phase protein gene transcription in west Greenland sledge dogs (*Canis familiaris*) dietary exposed to organic environmental pollutants.** *Archives of Environmental Contamination and Toxicology* 53(1): 110-118, 2007.

Notes: Exposure levels of persistent organic pollutants, such as polychlorinated biphenyls and DDTs, are high in Arctic apex predators and Inuit peoples and are suspected to have negative impacts on their immune systems. We conducted a controlled generational study on liver tissue and ethylenediaminetetra-acetic acid blood cytokine and acute-pbase protein (APP) mRNA expressions using reverse transcriptionase-polymerase chain reaction in West Greenland sledge dogs (*Canis familiaris*); contaminated minke whale (*Balaenoptera acutorostrata*) blubber serves as dietary pollutant source. Two of seven blood cytokine expressions (IL-6 and IL-12) and three of five APP expressions (haptoglobin [HP], heat shock protein, and fatty acid-binding protein [FABP]) were lowest in the exposed group, whereas the remaining five blood cytokine expressions (IL-2, IL-10, IFN-γ, TNF-α, and TGF-β) and two APP expressions (MTI and MT2) were highest in the exposed group. In liver tissue, three cytokine expressions (IL-10, IFN- γ, and TNF-α) and two APP expressions (MT1 and MT2) were highest in the exposed group, and the remaining cytokine and APP expressions were lowest in the exposed group. Of these, the liver tissue expression of HP and FABP was significantly lowest in the exposed group (both $p < 0.05$). As a consequence of our findings, we suggest that a daily intake of 50 to 200 g polluted whale blubber is associated with a genotoxic decrease in HP and FABP gene expression in the liver of sledge dog and possibly of other top mammalian marine predators and consumers in the Arctic, indicating a restricted acute-phase reaction and insufficient immune response. Finally, HP and FABP liver expression appear to be new and sensitive biomarkers of organohalogen compound exposure.

Dugdale, R.C., Wilkerson, F.P., Hogue, V.E., and Marchi, A. **The role of ammonium and nitrate in spring bloom development in San Francisco Bay.** *Estuarine, Coastal and Shelf Science* 73(1-2): 17-29, 2007.

Notes: The substantial inventory of nitrate (NO_3) in San Francisco Bay (SFB) is unavailable to the resident phytoplankton most of the year due to the presence of ammonium (NH_4) at inhibitory concentrations that prevents NO_3 uptake. Low annual primary productivity in this turbid estuary is generally attributed to the poor irradiance conditions. However, this may not be the only cause; spring phytoplankton blooms occur irregularly in north SFB; only when NH_4 concentrations are low, <4 μmol L^{-1} and NO_3 uptake by phytoplankton occurs. Field measurements and enclosure experiments confirm the NH_4 inhibition process to be the cause of low NO_3 utilization most of the year. Detailed analysis of spring blooms in three embayments of SFB over 3 years shows a consistent sequence of events that result in bursts of chlorophyll. The first requirement is improved irradiance conditions through stabilization of the water column by stratification or reduced tidal activity. Second, NH_4 concentrations must be reduced to a critical range, 1 to 4 pmol L^{-1} through dilution by precipitation and by phytoplankton uptake. This enables rapid uptake of NO_3 and subsequent increase in chlorophyll. The resulting bloom is due to both the initial uptake of NH_4 and the subsequent uptake of NO_3. The NO_3 uptake step is crucial since it is the larger nitrogen source and uptake occurs at higher rates than that for NH_4 at the concentrations that occur in SFB. Existing models of light-limited, non-nutrient limited productivity in SFB require modification to include the NH_4 inhibition effect. Prom measured NH_4 uptake rates and initial concentrations, calculations can be made to predict the length of time that favorable irradiance conditions are required for the phytoplankton population to reduce ambient NH_4 concentrations to non-inhibiting concentrations and allow bloom formation to begin. For Suisun Bay, the time required is so long that blooms are unlikely in any season. For San Pablo and Central Bays, these times are too long in summer but sufficiently short in spring to allow bloom development, depending on the ambient NH_4 concentration prior to the productivity season. NH_4 sources to SFB are primarily anthropogenic, from agricultural drainage and sewage treatment plants, and if not sufficiently diluted by runoff and precipitation can prevent development of the spring phytoplankton bloom. Attention should be paid to the form of N making up dissolved inorganic nitrogen (DIN) in nutrient-rich estuaries.

Doney, S.C., Mahowald, N., Lima, I., Feely, R.A., Mackenzie, F.T., Lamarque, J.-F., and Rasch, P.J. **Impact of anthropogenic atmospheric nitrogen and sulfur deposition on ocean acidification and the inorganic carbon system.** *Proceedings of the National Academy of Sciences [USA]* 104(37): 14580-14585, 2007.

Notes: Fossil fuel combustion and agriculture result in atmospheric deposition of 0.8 Tmol/yr reactive sulfur and 2.7 Tmol/yr nitrogen to the coastal and open ocean near major source regions in North America, Europe, and South and East Asia. Atmospheric inputs of dissociation products of strong acids (HNO_3 and H_2SO_4) and bases (NH_3) alter surface seawater alkalinity, pH, and inorganic carbon storage. We quantify the biogeochemical impacts by using atmosphere and ocean models. The direct acid/base flux to the ocean is predominately acidic (reducing total alkalinity) in the temperate Northern Hemisphere and alkaline in the tropics because of ammonia inputs. However, because most of the excess ammonia is nitrified to nitrate (NO_3^-) in the upper ocean, the effective net atmospheric input is acidic almost everywhere. The decrease in surface alkalinity drives a net air-sea efflux of CO_2, reducing surface dissolved inorganic carbon (DIC); the alkalinity and DIC changes mostly offset each other, and the decline in surface pH is small. Additional impacts arise from nitrogen fertilization, leading to elevated primary production and biological DIC drawdown that reverses in some places the sign of the surface pH and air-sea CO_2 flux perturbations. On a global scale, the alterations in surface water chemistry from anthropogenic nitrogen and sulfur deposition are a few percent of the acidification and DIC increases due to the oceanic uptake of anthropogenic CO_2. However, the impacts are more substantial in coastal waters, where the ecosystem responses to ocean acidification could have the most severe implications for mankind.

Andresen, J.A., Muir, D., Ueno, D., Darling, C., Theobald, N., and Bester, K. **Emerging pollutants in the North Sea in comparison to Lake Ontario, Canada, data.** *Environmental Toxicology and Chemistry* 26(6): 1081-1089, 2007.

Notes: In the present study, the concentrations and fate of contaminants such as organophosphate flame retardants and plasticizers, musk compounds such as galaxolide (HHCB), tonalide (AHTN), musk ketone and musk xylene, the bactericide triclosan, as well as the metabolites HHCB-lactone and triclosan-methyl were compared in the aqueous phase of the German Bight (North Sea). The concentrations of these compounds were around 1 to 10 ng/L in nearshore areas, and the concentrations were lower in the more pristine areas. The highest concentrations were determined for tris-(2-chloro-isopropyl) phosphate in the North Sea with concentration exceeding 10 ng/L even for the offshore samples. The samples contained 1 to 20 ng/L chlorinated organophosphates, approximately 1 ng/L nonchlorinated organophosphates, and 0.3 to 3 ng/L fragrance compounds. Some samples from Lake Ontario (Canada) were analyzed in comparison. Per capita emissions were calculated for both regions. These emissions were compared and turned out to be very similar for the Canadian and German locations. For the North Sea, some observations concerning stability, dilution, and degradation, as well as sources of the respective substances, were performed. These data indicate that the chlorinated organophosphates and some musk fragrances exhibit half lives exceeding the residence times and thus can be considered to be persistent in this ecosystem. In the German Bight, the river Elbe is the dominating source for the more hydrophilic compounds, such as chlorinated organophosphate flame retardants, which are diluted only into the North Sea. However, for the more lipophilic compounds such as the musk fragrances, different input patterns as well as distribution patterns are relevant, though the river Elbe is still a major source of pollution to the German Bight of the North Sea. The data seem to indicate either relevant inputs further west of the sampling area or mobilization from the sediments.

Dameron, O.J., Parke, M., Albins, M.A., and Brainard, R. **Marine debris accumulation in the Northwestern Hawaiian Islands: An examination of rates and processes.** *Marine Pollution Bulletin* 54(4): 423-433, 2007.

Notes: Large amounts of derelict fishing gear accumulate and cause damage to shallow coral reefs of the Northwestern Hawaiian Islands (NWHI). To facilitate maintenance of reefs cleaned during 1996-2005 removal efforts, we identify likely high-density debris areas by assessing reef characteristics (depth, benthic habitat type, and energy regime) that influence sub-regional debris accumulation. Previously cleaned backreef and lagoonal reefs at two NWHI locations were resurveyed for accumulated debris using two survey methods. Accumulated debris densities and weights were found to be greater in lagoonal reef areas. Sample weight-based debris densities are extrapolated to similar habitats throughout the NWHI using a spatial 'net habitat' dataset created by generalizing IKONOS satellite derivatives for depth and habitat classification. Prediction accuracy

for this dataset is tested using historical debris point data. Annual NWHI debris accumulation is estimated to be 52.0 metric tonnes. For planning purposes, individual NWHI atolls/reefs are allotted a proportion of this total.

O'Connor, T. and Whitall, D. **Linking hypoxia to shrimp catch in the northern Gulf of Mexico.** *Marine Pollution Bulletin* 54(4): 460-463, 2007.

Notes: Wide spread and reoccurring hypoxia has been observed in the northern Gulf of Mexico since routine monitoring began in the 1980s. Although the potential ecological effects of hypoxia (habitat loss, mortalities) are well known, there is relatively little information linking hypoxia in the northern Gulf of Mexico to fisheries decline. Previous analyses have shown a negative relationship between hypoxic area and brown shrimp (*Farfantepenaeus aztecus*) catch for the Texas and Louisiana coasts combined from 1985 to 1997. Extending these analyses with data through 2004, we found that the correlation between hypoxic area and landings holds (r = -0.52), plus there was a significant negative relationship (r = -0.59) between hypoxia and shrimp landings for the Texas coast alone. We hypothesize that this pattern is not seen in the Louisiana fishery alone because of differences in fisheries practices (inshore vs. offshore) between Louisiana and Texas.

Nielsen, L.W. and Dahllof, I. **Direct and indirect effects of the herbicides Glyphosate, Bentazone and MCPA on eelgrass (*Zostera marina*).** *Aquatic Toxicology* 82(1): 47-54, 2007.

Notes: Eelgrass beds are important habitats for many organisms, but there has been a decline in the area covered by eelgrass during the last decades due to increased eutrophication resulting in increased shading from phytoplankton. The use of herbicides in terrestrial agriculture has also increased over the last century, and while the effects of herbicides on non-target organisms have been well studied in freshwater they are overlooked in coastal waters. It is not known if herbicides have any effect on the distribution of eelgrass (*Zostera marina*), or how natural phytoplankton communities respond to the same herbicides. Direct and indirect effects of the herbicides Glyphosate, Bentazone and MCPA both as single toxicants and as mixtures, on the eelgrass plants were investigated in this study. The direct effects on eelgrass were examined by measuring the four different endpoints; the relatively growth rate as length and weight, the chlorophyll a and b ratio, as well as the RNA-DNA ratio, at the end of a 3 days exposure period. The indirect effect was investigated by measuring the effect on a natural phytoplankton production from Roskilde Fjord six times during 1 year. The results showed that the chlorophyll a-b and RNA-DNA ratios were the most sensitive endpoints in single herbicide experiments. The effects of herbicide mixtures on eelgrass were much larger compared to the single substances. Nearly a halving was found for both the relatively growth rate in length and weight, and the RNA-DNA as well as the chlorophyll a-b ratios were also significant reduced. This indicates a possible synergistic effect, and calculations based on the concentration addition model indicate that the low concentrations mixture has a synergistic effect, whereas the high concentration mixture has an antagonistic effect on eelgrass (*Z. marina*). The low concentrations mixture is the one with the highest relevance for coastal areas. The effect on phytoplankton showed some variation over the year but mainly in a stimulation in primary production. This means that herbicides affect eelgrass both directly and indirectly.

Bellas, J. **Toxicity of the booster biocide Sea-Nine to the early developmental stages of the sea urchin *Paracentrotus lividus*.** *Aquatic Toxicology* 83(1): 52-61, 2007.

Notes: The toxicity of the alternative antifouling compound Sea-Nine to the early developmental stages of the sea urchin *Paracentrotus lividus* was investigated. The inhibition of the fertilization rate and the induction of transmissible damages to the offspring, measured as inhibition of embryonic development and larval growth, were studied by preexposure of gametes to a range of Sea-Nine concentrations. Sperm and egg exposures resulted in a significant decrease of the fertilization rate and induced a transmissible damage to the offspring. The effects of Sea-Nine throughout the embryonic development were also studied by a 48 h exposure of fertilized eggs. The larval growth was the most sensitive response tested, with toxic effects detected at 8.6 nM = 2.4 μg/L (EC10). The inhibition of *P. lividus* embryonic development and larval growth was also used to study the loss of toxicity in Sea-Nine solutions exposed for 8 h to direct sunlight and maintained for 28 h in dark conditions. The results showed that the toxicity of Sea-Nine solutions did not decrease but a slight increase in toxicity was observed in comparison with control solutions. The risk of Sea-Nine maximum concentrations measured in marinas around Europe to *P.*

lividus early developmental stages was calculated and the obtained risk quotient was 5.5, indicating that adverse ecological effects of this compound are likely to occur.

Wang, D.L., Atkinson, S., Hoover-Miller, A., and Li, Q.X. **Polychlorinated naphthalenes and coplanar polychlorinated biphenyls in tissues of harbor seals (*Phoca vitulina*) from the northern Gulf of Alaska.** *Chemosphere* 67(10): 2044-2057, 2007.

Notes: Blubber, liver and kidney samples of harbor seals (*Phoca vitulina*) from the northern Gulf of Alaska were collected during 2000-2001 for the analysis of polychlorinated naphthalenes (PCNs) and coplanar polychlorinated biphenyls (Cop/PCBs). On the lipid weight (lw) base, the total concentrations of PCNs (ΣPCNs) ranged from 0.3 to 27 ng/g lw, and the total concentrations of Cop/PCBs (ΣCop/PCBs) were 3.6-546 ng/g lw in all the tissue samples. Di-ortho PCBs and mono-ortho PCBs were dominant followed by non-ortho PCBs and PCNs. Σmono-ortho PCBs and Σdi-ortho PCBs in nursing seals were apparently lower than those in male adult seals, but ΣPCNs and Σnon-ortho PCBs in female adults were not significantly different from those in male adults. Differences in PCNs and Cop/PCBs congener profiles in female and male adult seals are apparently related to their chemical structure and properties, animal's developmental stages and physiological conditions. A large quantity of mono-ortho and di-ortho PCBs might be transferred to newborns from the nursing seals during lactation, while non-ortho PCBs and PCNs were relatively accumulative in the mother seals. ΣPCNs and ΣCop/PCBs in the harbor seals correlated with ages, gender, body weight and blubber thickness, but the blubber ΣPCNs and ΣCop/PCBs in Kodiak Island and Southern Alaska Peninsula (KIAP) did not significantly differ from those in Prince William Sound (PWS). In addition to the new PCB data, this first report on PCN contamination in Alaskan harbor seal tissues is useful for the wildlife and ecosystem management and human health protection.

Medina, M.H., Correa, J.A., and Barata, C. **Micro-evolution due to pollution: Possible consequences for ecosystem responses to toxic stress.** *Chemosphere* 67(11): 2105-2114, 2007.

Notes: Polluting events can change community structure and ecosystem functioning. Selection of genetically inherited tolerance on exposed populations, here referred as micro-evolution due to pollution, has been recognized as one of the causes of these changes. However, there is a gap between studies addressing this process and those assessing effects at higher levels of biological organization. In this review we attempt to address these evolutionary considerations into the ecological risk assessment (ERA) of polluting events and to trigger the discussion about the consequences of this process for the ecosystem response to toxic stress. We provide clear evidence that pollution drives micro-evolutionary processes in several species. When this process occurs, populations inhabiting environments that become polluted may persist. However, due to the existence of ecological costs derived from the loss of genetic variability, negative pleiotropy with fitness traits and/or from physiological alterations, micro-evolution due to pollution may alter different properties of the affected populations. Despite the existence of empirical evidence showing that safety margins currently applied in the ERA process may account for pollution-induced genetic changes in tolerance, information regarding long-term ecological consequences at higher levels of biological organization due to ecological costs is not explicitly considered in these procedures. In relation to this, we present four testable hypotheses considering that micro-evolution due to pollution acts upon the variability of functional response traits of the exposed populations and generates changes on their functional effect traits, therefore, modifying the way species exploit their ecological niches and participate in the overall ecosystem functioning.

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von der Recke, R. and Vetter, W. **Synthesis and characterization of 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE) and structurally related compounds evidenced in seal blubber and brain.** *Environmental Science and Technology* 41(5): 1590-1595, 2007.

Notes: The unknown compound UBC-1 previously described as the major organobromine contamination in the blubber extract of a hooded seal (*Cystophora cristata*) from the Barents Sea was identified as 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DPTE). DPTE, which is the main component of the brominated flame retardant (BFR) Bromkal 73-5 PE, was synthesized by electrophilic addition of bromine to allyl-2,4,6-tribromophenyl ether (ATE). The chirality of DPTE was proven by gas chromatographic enantioseparation of the synthesized racemate. On the basis of GC/ECNI-MS ion chromatograms (m/z 79 and 81), DPTE was the dominating organobromine compound in blubber and brain samples of hooded seals and

harp seals (*Phoca groenlandica*) from the Barents and Greenland Seas. The concentrations of DPTE in blubber and brain were up to 470 and 340 μg/kg wet weight. Next to DPTE, the natural dibromo-trichloro-monoterpene (MHC-1), the anthropogenic BDE 47 and BDE 99, as well as ATE, 3,5-dibromo-2-(2',4'-dibromo)-phenoxyanisole (6-MeO-BDE 47), 2-bromoallyl-2,4,6-tribromophenyl ether (BATE), and 4,6-dibromo-2-(2',4'-dibromo)-phenoxyanisole (2'-MeO-BDE 68) were present with decreasing relevance. BATE, which was detected for the first time in environmental samples, was synthesized from DPTE by E2 elimination. In brain samples of the harp seals, DPTE, ATE, and BATE were the most abundant organobromine compounds, whereas polybrominated diphenyl ethers (PBDEs) and MHC-1 were virtually absent. This indicated that DPTE, ATE, and BATE were able to penetrate the blood-brain barrier. The general co-occurrence of ATE and BATE in samples contaminated with DPTE support the hypothesis that these compounds are biotransformation products of DPTE. Anaerobic transformation studies of DPTE with super-reduced corrinoids resulted in the formation of ATE. Furthermore, 2,4,6-tribromophenol (TBP) and two other unknown minor transformation products were detected.

Diez, S., Jover, E., Bayona, J.M., and Albaiges, J. **Prestige oil spill. III. Fate of a heavy oil in the marine environment.** *Environmental Science and Technology* 41(9): 3075-3082, 2007.

Notes: More than 200 oil samples were collected along the Northern Spanish coast, from December 2002 to December 2003, as part of the extensive monitoring program carried out by the Spanish Marine Safety Agency after the Prestige heavy oil spill (November 13, 2002). The GC FPD/FID and comprehensive GC x GC/TOFMS sample profiles revealed the main characteristics of the oil residues. Chemical fingerprinting of the aliphatic and aromatic fractions by GC/MS was performed to determine the source of the oil as well as to follow its weathering at sea. The (n-C_{13} + n-C_{14})/(n-C_{25} + n-C_{26}), n-C_{18}/phytane, and methylnaphthalene [(N + N1)/N2] ratios were found to be useful for assessing the evaporation, biodegradation, and dissolution processes, respectively. Other indicators of more advanced degradation processes, including photo-oxidation, were unaltered, showing the low incidence of natural weathering processes on the spilled heavy oil 1 year after the accident. The survey also demonstrated the occurrence of continued discharges of ballast waters at sea and the need for a more stringent surveillance of the area, beyond accidental oil spills.

Bone, S.E., Charette, M.A., Lamborg, C.H., and Gonneea, M.E. **Has submarine groundwater discharge been overlooked as a source of mercury to coastal waters?** *Environmental Science and Technology* 41(9): 3090-3095, 2007.

Notes: We measured the mercury (Hg) in groundwater, aquifer sediments, and surface water in Waquoit Bay (Massachusetts) and found that this toxic metal (range: < 3.2-262 pM) was being released within the subterranean estuary, with similarly high levels (range: 18-256 pM) found in the surface waters of the bay. None of the dissolved species (DOC, chloride, and Fe) normally observed to influence Hg partitioning correlated well with the observed Hg concentrations. It was hypothesized that this was in part due to the variable loading in time and space of Hg onto the aquifer sands in combination with the seasonality of groundwater flow through the aquifer. Aquifer sediment samples from the study site ranged from < 1 to 12.5 pmol of Hg/g of sediment, suggesting log K-d values on the order of 1. We hypothesize that this was due to the low organic carbon content typical of the aquifer sediments. Last, it was estimated that submarine groundwater discharge supplied 0.47-1.9 nmol of Hg m^{-2} day^{-1} to the bay, which is an order of magnitude higher than the atmospheric deposition rate for the northeastern U.S.

Miranda-Filho, K.C., Metcalfe, T.L., Metcalfe, C.D., Robaldo, R.B., Muelbert, M.M.C., Colares, E.P., Martinez, P.E., and Bianchini, A. **Residues of persistent organochlorine contaminants in Southern elephant seals (*Mirounga leonina*) from Elephant Island, Antarctica.** *Environmental Science and Technology* 41(11): 3829-3835, 2007.

Notes: Contamination of blubber tissues by organochlorine pesticides (OC) and PCBs was assessed in female and male pups and juveniles, as well as in adult females and subdominant adult males of the Southern elephant seal, *Mirounga leonina*, from Elephant Island in the Antarctic Peninsula. All residues of persistent organochlorine contaminants analyzed were found in blubber samples, except for β-HCH, endosulfan II, endrin, heptachlor, and aldrin. The relative concentrations of the analytes detected were ΣDDT > ΣPCB > Σchlordane > mirex > dieldrin > HCB > Σendosulfan > methoxychlor > ΣHCHs > other OC pesticides. OC and PCBs concentrations were 1 or 2 orders of magnitude lower than those found in pinnipeds from northern hemisphere. The ratio ΣDDT/SPCB was higher in southern elephant seals. The relative importance of some OC

residues indicates that pesticides used either currently or in the recent past in countries in the southern hemisphere are the sources of contamination in the Antarctic region. Data showed that concentrations of contaminants generally increased from pups < juveniles < adults and suggested that pups accumulated contaminants through transfer from the mother seals via transplacental and lactational routes.

Burger, J. **A framework and methods for incorporating gender-related issues in wildlife risk assessment: Gender-related differences in metal levels and other contaminants as a case study.** *Environmental Research* 104(1): 153-162, 2007.

Notes: Gender plays a role in the genetics, physiology, morphology, and behavior of organisms, and thus influences the uptake, fate, and effects of contaminants in organisms. There are a number of chemical analysis tools, as well as biological approaches to understanding the influence of gender on contaminant levels and effects in wildlife. Biological approaches occur at all levels, from mutagenesis, gene expression and biochemistry, to physiology, morphology and development, to pathology and behavior. Information on the effects of gender at all these levels is essential for model building, risk assessment, and developing biomonitoring plans. Gender influences both internal and external fate and effects. However, bioaccumulation and effects cannot occur without exposure, which is mediated by behavior, bioavailability, bioaccessibility, and absorption. Gender influences a number of individual features (size, nutrition, genetics, hormones), that in turn affect niche differentiation, leading back to differences in exposure and susceptibility. Both sexes have a variety of methods of ridding the body of contaminants, through the bile, urine, exhaled air, and sloughing of epidermal structures (skin, hair, feathers). Females can also rid their body of contaminants through egg contents and egg shells, or mammals by transfer to the developing fetus and through breast milk. The availability of contaminant data in wildlife depends partly on the ease of identification of the sexes by either external or internal examination. Thus, there are more data on contaminant levels in birds and mammals than in fish. Surprisingly, metal levels are not uniformly low in females, even when they are morphologically smaller than males. For 43 studies of metals in vertebrates, females had higher levels in 30 cases where there were significant differences (and males were higher in only 14 cases). Females usually had higher levels of mercury than males. Review of the literature suggests that authors should clearly describe the gender differences in their abstracts (not just say they exist), and if they found no differences, state whether they had sufficient power to identify such differences.

Fossi, M.C., Casini, S., and Marsill, L. **Potential toxicological hazard due to endocrine-disrupting chemicals on Mediterranean top predators: State of art, gender differences and methodological tools.** *Environmental Research* 104(1): 174-182, 2007.

Notes: Man-made endocrine-disrupting chemicals (EDCs) range across all continents and oceans. Some geographic areas are potentially more threatened than others: one of these is the Mediterranean Sea. Levels of some xenobiotics are much higher here than in other seas and oceans. In this paper we review the final results of a project supported by the Italian Ministry of the Environment, in which the hypothesis that Mediterranean top predator species (such as large pelagic fish and marine mammals) are potentially at risk due to EDCs was investigated. We illustrate the need to develop and apply sensitive methodological tools, such as biomarkers (Vitellogenin, *Zona Radiata* proteins and CYP1A activities) for evaluation of toxicological risk in large pelagic fish top predators (Swordfish, (*Xiphias gladius*), Bluefin Tuna (*Thunnus thymms thynnus*)) and nondestructive biomarkers (CYPIA activities and fibroblast cell culture in skin biopsy), for the hazard assessment of threatened marine mammals species (Striped Dolphin, (*Stenella coerideoalba*), Bottlenose Dolphin (*Tursiops truncatus*), Common Dolphin (*Delphinus delphis*) and Fin Whale (*Balaenoptera physalus*))exposed to EDCs. Differential gender susceptibility to EDCs is also explored both in large pelagic fish and in cetaceans. In cetaceans, male specimens showed higher cytochrome P450 induction (BPMO in skyn biopsies, CYP2B in fibroblasts cell cultures) by xenobiotics with respect to females.

McClellan-Green, P., Romano, J., and Oberdorster, E. **Does gender really matter in contaminant exposure? A case study using invertebrate models.** *Environmental Research* 104(1): 183-191, 2007.

Notes: Exposure to contaminants in the environment is indiscriminate and multiple species/populations of all sexes are potentially at risk. In this paper we examine the current information available on gender specific differences in invertebrates following exposure to environmental contaminants. Because of their close association with the environment and diversity of habitats, invertebrates are uniquely at risk for adverse responses to pollutants. Since 97% of all animal species are

invertebrates, it would be impossible to cover each of the phyla in this review. Instead, this paper discusses major invertebrate species including insects (*Periplaneta americana*, *Panorpa vulgaris*, *Lycosa hilaris*, *Haematobia irritans irritans* (L.), and *Drosophilia melanogaster*), nematodes (*Caenorhabditis elegans*), crustaceans (*Streptocephalus dichotomus*, *Amphiascus tenuiremis*, *Microarthrialion littorale*, *Tisbe bulbisetosa*, *Acartia tonsa*, and *Palaemonetes pugio*), mollusks (*Pinctada fucata martensii*, *Ilyanassa obsoleta*, *Nucella lapillus*, *Hinia reticulata*, *Thais clavigera*, and *Mercenaria mercenaria*), corals (*Euphyllia ancora* and *Montipara capitata*), and echinoderms (*Asterias rubens*) that have been used in studies examining the differences between mates and females. Our discussion focuses on gender differences that occur in both toxicokinetic mechanisms (uptake and elimination, metabolism and physiology) and other toxicological endpoints (survival and behavior as well as morphology and development). It will become evident that the endocrine systems of invertebrates have many traits and/or pathways that are comparable to those observed in higher organisms. Yet the sensitivity of some elements of the invertebrate endocrine system, e.g., disruption of neuropeptide hormone signaling following TBT exposure, highlights the uniqueness of their systems and their potential for disruption.

Orlando, E.F. and Guillette, L.J. **Sexual dimorphic responses in wildlife exposed to endocrine disrupting chemicals.** *Environmental Research* 104(1): 163-173, 2007.

Notes: Understanding the gender similarities and differences in how organisms respond following exposure to environmental chemicals is important if we are to determine the relative risk of these agents to wildlife and human populations. In this paper, we have chosen to focus on the sex determination and differentiation of fishes, amphibians, and reptiles, because of their close association with the environment and the number of environmental factors (e.g., temperature and endocrine disrupting chemicals) that are known to affect these phenomena in these taxa. We have discussed examples of gender differences in response to exposure to endocrine disrupting chemicals and found gender similarities about as often as we found differences. We found that most studies examined either one sex exclusively, or the experimental design did not include examining the effect of sex as a variable. Given the central role of sex steroid hormones in the sex determination and sexual differentiation of fishes, amphibians, and reptiles, we recommend that future research purposefully include sex as a factor, so that risk assessment by government agencies can address the probable gender differences in effects from exposure to chemicals in the environment.
