

ORGANIC CONTAMINANTS AS A THREAT IN THE WIDER CARIBBEAN REGION

— Dana Wetzel

Chemical contaminants of particular concern in the WCR include a variety of organic compounds such as oil-related toxicants called polycyclic aromatic hydrocarbons (PAHs) and a variety of other persistent organic pollutants (POPs) such as pesticides, brominated flame retardants, and polychlorinated biphenyls (PCBs). However, there is incomplete understanding of the levels and types of contaminants found in most Caribbean coastal waters, as well as regarding the range of effects of contaminants on wildlife. As noted, it is important, in the face of global climate change and the consequent, expected environmental changes to initiate studies to establish baseline values against which to assess change in the future. Such studies are included among the recommendations in the emerging draft Marine Mammal Action Plan for the WCR (UNEP 2005) as well as the more general Global Environmental Outlook report (UNEP 1997).

In the Caribbean, in general, 50% of the coastlines suffer from high or moderate potential threats due to coastal development, chronic pollution, oil spills or other factors. Major sources of contamination include untreated sewage, agricultural run-off, industrial wastes, mining, and leaks of oil from tanks, refineries, and other sources (UNEP 1997). The oil industry represents the single greatest industrial polluter. In Trinidad and Tobago, in particular, PAH contamination (from oil and gas) has been documented as a serious issue (Siung-Chang 1997).

One of the more widespread species of marine mammal in the WCR is the West Indian manatee, an herbivorous species. Scientists have suggested that their low trophic level reduce the vulnerability of manatees to organic contaminants. In a pilot study, however, manatees sampled in Mexico and Florida have alarmingly high levels of certain organic contaminants (most notably PCBs and chlorinated pesticides) that may exceed toxic thresholds for that species (Wetzel et al., unpublished).

Although pollution is likely to affect organisms at all trophic levels, the cetaceans are considered to be excellent sentinels of environmental health and status due to their longevity, high trophic level, and other factors (Wells et al. 2004). Therefore, assessments of pollutant types and levels in cetaceans not only have intrinsic value in terms of understanding threats to the health of particular whale or dolphin stocks, but can also provide important insights into possible health threats to humans.

Assessing Organic Contaminants in Marine Mammals and Fish

Polycyclic aromatic hydrocarbons (PAHs) are natural constituents of oil that enter coastal environments via release from outboard engines and accidental discharges (e.g. boat collisions, overturned or sunk vessels, petroleum spills), and can have cytotoxic, genotoxic, immunotoxic, and carcinogenic effects on aquatic wildlife. Although marine mammal scientists have devoted considerable attention to body burdens of certain contaminants, the PAHs have been largely ignored (O'Shea 1999). Ongoing studies by Wetzel and Reynolds involving both manatees (in Florida and Mexico, noted above) and several Arctic marine mammals represent two of the few endeavors to create baselines and establish body burdens of PAHs in marine mammals.

Potential relationships between halogenated aromatic hydrocarbon (HAH) and/or PAH exposure and health complications have been hypothesized to occur in a number of marine mammal populations. For example, high rates of cancer have been observed in beluga whales residing in the St. Lawrence estuary, a site highly contaminated by PAHs, HAHs, and organochlorine pesticides (Martineau et al., 2002). Immunosuppressive effects believed to be responsible for

making marine mammals more susceptible to fatal viral infections also have been attributed to PAH exposure (e.g., Aguilar and Borrell, 1994; Ross et al., 1996)

Nonetheless, most studies of toxicants in marine mammals have focused on organochlorines (OCs), polychlorinated biphenyls (PCBs), or a few metals (O'Shea 1999). Levels and effects of PAHs have rarely been assessed in these animals, even given the short and long-term effects that have been shown following the Exxon Valdez spill 15 years ago (Peterson et al., 2003).

The OCs include pesticides used widely in the Caribbean and elsewhere. As noted, studies of body burdens of pesticides in marine mammals have been relatively common in some parts of the world, even though it has been difficult to establish cause-and effect relationships between particular body burdens and specific pathologies. Current knowledge about pesticides demonstrates that they: a) are extremely persistent in the environment; b) bio-accumulate in lipid-rich tissues of marine mammals and other organisms; and c) may have a wide range of health effects in marine mammals, including direct mortality, impairment of reproduction or immune function (leading to lowered resistance to diseases), and carcinogenesis. Pesticides have been evaluated in approximately two dozen species of pinnipeds, five dozen cetacean species, the polar bear, the sea otter, and two species of sirenians (see review by O'Shea 1999).

A class of contaminants that is creating considerable concern is the polybrominated diphenyl ethers (PBDEs). The lipophilic and highly persistent chemicals are used as flame retardants in everyday products such as furniture foam, draperies, upholstery, consumer electronics, wire insulation, personal computers and small appliances. These chemicals are able to slow ignition and rate of fire growth and have helped to save lives. However, PBDEs have been associated with liver, thyroid and neurodevelopmental toxicity and are being found in human breast milk, fish, aquatic birds, and elsewhere in the environment (<http://www.epa.gov/oppt/pbde/>).

In marine and freshwater fishes, the PBDEs and PCBs rank among the organic contaminants of greatest interest for human health, at least in the United States (EPA 2005). Because their deposition patterns are driven by atmospheric forces, rather than by local point sources, the PBDEs and PCBs would be of particular interest in fish and other living resources of the wider Caribbean. Wetzel et al. (unpublished) found unexpectedly high levels of PCBs in manatees from southeastern Mexico, given their position in the food web.

Metals and elements of concern

O'Shea (1999) provides a review of the scientific literature regarding organic and inorganic contaminants in marine mammals. Among the metals and elements of greatest concern are the following: cadmium, lead, mercury, selenium, and copper.

Unlike most of the organic contaminants described above, elements occur naturally and many are essential to maintain normal metabolism and health. However, when found at elevated levels, even the essential elements can become toxic.

For many species of marine mammals, toxic doses and levels of elements are unknown. Generally, there is a focus on those elements known to cause toxicity in humans---notably mercury, cadmium and lead.

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