Wildlife Health Australia

Australian marine mammals and pollutants

Fact sheet

Introductory statement

Health impacts resulting from pollutant ingestion form part of the cumulative threat to the well-being and viability of many animal populations. In marine mammals the health impacts of pollutants are known to include abnormal function of the immune and endocrine systems (Sormo et al. 2009; Routti et al. 2010). Therefore, assessment of threats to Australian marine mammal populations should include consideration of their pollutant challenge and the significance of this challenge to individual and population health parameters.

Aetiology

A huge number of anthropogenic substances capable of polluting ocean waters are produced globally. These can be divided into chemical compounds and metals. Only a few classes of chemical compounds, usually those associated with serious health effects in humans or other terrestrial species have been surveyed in marine mammals. Of particular importance due to their demonstrated toxicity, chemical stability and resistance to metabolic degradation are the organochlorine (OC) compounds. These include DDT and its metabolites and the polychlorinated biphenyls (PCBs). Metal pollutants are those non-essential for the normal functioning of the body or those essential but ingested in excessive amounts. Metals are introduced into the environment and thereby ingested by animals by both natural (e.g. weathering of volcanic soils) and anthropogenic means such as run-off from industrial enterprises.

Natural hosts

Pollutants such as OCs and mercury bio-accumulate in the food web resulting in a tendency for animals feeding at higher trophic levels, such as many of the marine mammal species, to have higher tissue concentrations compared to those feeding at lower levels. The pollutant challenge is therefore dependant on the foraging strategy of the marine mammal species and the distributions of sub-populations of the species. In addition, dietary intake of pollutants often will vary with fluctuations in prey species, age class, gender and physiological status as all can influence foraging behaviour.

Geographical distribution

The OC and metal pollutant loads in marine mammals on a regional and species basis has been reviewed (Evans 2003). It appears that overall concentrations of OCs were lower in Southern Hemisphere marine mammals compared to those in the Northern Hemisphere but considerable variations were found between species and areas. The availability of data for Australian marine mammals is limited temporally and on a species basis. However, concentrations of OCs in Australian marine mammals appear to be in the same order of magnitude as those reported to be associated with health impacts in marine mammal species elsewhere (Martineau et al. 1994; Lahvis et al. 1995). Similarly, concentrations of metals in both Northern and Southern hemisphere species varied widely with species and area. Specific health impacts associated with metal pollutants are largely unknown but Australian marine mammals were found to have tissue concentrations of mercury which would reflect ingestion from both natural and anthropogenic sources.

Clinical pathology

The distribution of pollutants within the body varies with both pollutant and tissue type. OCs are lipophilic and therefore accumulate in the highest concentrations in the body's fat stores. Metal pollutants distribution varies depending on the element but tend to accumulate most readily in the liver and kidney. It is therefore important when assessing marine mammals for pollutant loads assessment to at least sample these two tissues plus subcutaneous fat. Concentrations are usually reported as the sum of various isomers or congeners of pollutant classes (e.g. ∑DDT or ∑PCB). Comparison between studies requires knowledge of the number of isomers or congeners that contributed to the results plus whether results are dry weight, wet weight or lipid weight basis.

Pathology

The immunosuppressive effects of OCs have been demonstrated in numerous free living marine mammal species and this may make individuals with high OC burdens more susceptible to opportunistic infections (Lahvis et al. 1995; Kannan et al. 2007; Sormo et al. 2009). Endocrine disruption, reproductive failure and bone lesions associated with OCs have also been reported in marine mammals (Routti et al. 2008; Routti et al. 2010; Wang et al. 2010). Of the metal pollutants, the effect of excessive mercury tissue concentrations is most often reported in marine mammals. In-vitro studies suggest mercury can result in immunosuppression by impairing lymphocyte function (Kakuschke 2009), A recent study in Bottlenose dolphins from South Australian waters suggested that renal damage and bone malformations observed in post mortem where associated with chronic exposure to metal pollutants (Lavery 2009).

Further information on pathology associated with pollutants in marine mammals is available from the Australian Registry of Wildlife health (http://www.arwh.org/).

Laboratory diagnostic specimens

Live marine mammals

- Subcutaneous fat (at least 1g) wrapped in foil and frozen for OCs
- Whole blood (1ml) frozen for OCs and metals

- Hair (seals – at least 100ug) for metals

Post mortem examination: Samples listed above plus

- Liver (at least 5g) frozen for metals
- Kidney (at least 5g) frozen for metals
- Skeletal muscle (at least 5g frozen) for metals

Laboratory procedures

- Gas chromatography-mass spectrometry (GC-MS): OCs
- Atomic absorption spectrophotometer: metals
- Inductively coupled plasma mass spectrometry (ICP-MS): metals

Research

The levels of potentially harmful pollutants in most Australian marine mammal species are unknown. For those species that have been subject to toxicological assessments, sampling has largely occurred over a limited part of their distribution and mostly within a limited time frame. For adequate baseline information on the pollutant challenge faced by Australian marine mammals, surveillance activities need to be greatly expanded.

Very few studies have investigated the impacts of pollutants on the health of Australian marine mammals. Investigations of marine mammal mortality and disease incidence should, where possible, include consideration of the potential contribution of pollutants.

Conclusions

Ingested pollutants are well known to have the potential to adversely affect health of animal species. Many marine mammal species occupy high trophic positions in the food web and therefore may bio-accumulate persistent organic compounds such as organochlorins. Information on baseline levels of pollutants in most Australian marine mammals across most of their distribution is currently lacking.

References and other information

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To provide feedback on this fact sheet

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Wildlife Health Australia would be very grateful for any feedback on this fact sheet. Please provide detailed comments or suggestions to admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and would like to produce a fact sheet (or sheets) for the network (or update current sheets). A small amount of funding is available to facilitate this.

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