

PERFLUORINATED COMPOUNDS: NEW THREAT FOR MARINE MAMMALS

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The global marine ecosystem is continuously under pressure due to expanding anthropogenic activities and the development and release of new chemicals. High contaminant burdens in animals from higher trophic levels, such as marine mammals, have led to a need for more information on the occurrence, distribution and fate of several hazardous compounds. Recently, a growing concern has been expressed about the environmental fate of perfluorinated organic chemicals. Perfluorinated alkylated substances (PFAS), with perfluorooctane sulfonic acid (PFOS) as the major representative of this class, are highly persistent in the environment, have a strong tendency to bioaccumulate, and have been found in blood of the general human population as well as in wildlife, indicating that exposure to the chemicals is widespread. However, little is known on their specific accumulation patterns and their toxicological mode of action.

In this study, we want to give an overview of the occurrence of PFAS in the European marine environment, and more specifically in marine mammals originating from the coasts along the North Sea from Norway to France, and from the Ukrainian coast of the Black Sea. For this purpose, nine species of marine mammals were collected and different perfluorinated chemicals were measured in various tissue extracts using high performance liquid chromatography combined with electrospray tandem mass spectrometry (HPLC-MS/MS). In order to explain the differences in PFOS concentrations between the organisms and to evaluate the potential of PFOS to be biomagnified along the food chain, we investigated the behaviour of PFOS and other PFAS within higher trophic levels using stable nitrogen ($\delta^{15}\text{N}$) and carbon ($\delta^{13}\text{C}$) isotope ratios.

PFOS was the predominant compound in all samples measured (ranging from below the detection limit to 2724 ng/g wet weight), although large variations between species and between tissues were monitored. Levels of other PFCs were much lower than PFOS concentrations. Although there is a trend visible in female animals, having higher hepatic and kidney PFOS concentrations than males, results differ between studies and depend on which animal and which tissue has been taken. The present results suggest a difference in accumulation pattern of PFCs compared to that of persistent organochlorinated chemicals.

In order to evaluate the interspecies differences, we developed PFOS-trophic level relationships based on stable nitrogen and carbon isotope ratios. Animals that display the highest trophic positions (highest $\delta^{15}\text{N}$) have the highest PFOS levels. The different feeding ecology of these species (inshore versus offshore) also seems to contribute to

differences in PFOS concentrations. Apparently, concentrations of PFOS and related chemicals are increasing near more populated and industrialized regions. However, PFOS levels up to 52.08 ng/g wet wt in sperm whales which feed mainly on abyssal cephalopods, but also on bottom-dwelling organisms, suggest that fluorinated organic compounds have not only reached coastal regions, but also deeper water layers.