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Flame Retardants: Alternatives and Legacy in Marine Mammals from Three Northern Ocean Regions

Malene Bergose*

Department of Environmental sciences, Jimma University, Ethiopia

Abstract

Flame retardants are widely dispersed pollutants that have been connected to detrimental impacts on human and wildlife health. One of the many man-made factors endangering the health of the population is the bioaccumulation of flame retardants and other contaminants in the tissues of marine mammals, which are top predators. Although certain flame retardants, like polybrominated diphenyl ethers (PBDE), have been outlawed due to their proven toxicity and environmental persistence, there is little information available regarding the presence and distribution of alternative flame retardants that are currently in use in marine mammals from both remote and industrialized parts of the globe. Thus, taking into account regional, species, age, body condition, temporal, and tissue factors, this study measured 44 legacy and alternative flame retardants in nine marine mammal species from three ocean regions: the Northwest Atlantic, the Arctic, and the Baltic.

Keywords: Marine mammals; Northern ocean; Bioaccumulation

Introduction

By 2050, almost 40% of marine mammal species are expected to go extinct, with polar species experiencing severe habitat change brought on by climate change most at risk. Pack ice is essential for ice-breeding seals, and its disappearance due to climate change will cause prey availability to shift toward the poles. Other threats to marine mammals' well-being include habitat destruction, hunting, bycatch, ecotourism, underwater noise, and environmental pollution, all of which compound to jeopardize the population's health in the future [1,2].

Methodology

According to Alaee, flame retardants are organic chemicals that are halogenated or phosphate-based and are added to a variety of products to increase their resistance to fire. These chemicals are now found worldwide in sediments, water, air, and aquatic and terrestrial biota at all trophic levels. Many of these flame retardants have also been connected to detrimental health effects, such as endocrine disruption, in both humans and wildlife [3].

Certain flame retardants, like polybrominated diphenyl ethers (PBDEs), have been outlawed in numerous nations due to their extensive use, environmental persistence, and proven health risks. But since PBDEs are illegal, more chemicals that were previously produced in small quantities are now produced, and many "novel" or "alternative" flame retardants have been created. There is now evidence of these substitute flame retardants in wildlife worldwide [4,5].

Understanding global patterns is made more challenging by the fact that previous studies of flame retardant contamination in marine mammals have typically concentrated on a single geographic area or a small number of species. Thus, in the blubber of nine marine mammal species from three northern ocean regions—the Northwest Atlantic, represented by samples from the northeastern U.S. coast; the Arctic, represented by samples from Greenland and Iceland; and the Baltic, represented by samples from Iceland—the concentrations of 44 flame retardants, including legacy PBDE congeners, Dechlorane-related compounds, and alternative brominated flame retardants—were measured. The industrialized nations that encircle the Northwest Atlantic and the Baltic have a long history of contaminating the environment [6-8].

This investigation also examined the amounts of contaminants in two distinct tissues by examining liver and blubber samples from certain Northwest Atlantic and Baltic harbor seals (Phoca vitulina). According to Ellisor liver, which is blood-perfused and has an active metabolism, may be a more reliable indicator of recent exposure and possible toxicity than brain, which serves as a major reservoir for lipophilic compounds and integrates lifetime accumulation of pollution. Tissue comparisons offer a more comprehensive assessment of the level of contamination and help to understand the bioaccumulation dynamics of various chemicals. This extensive study addressed the dearth of information regarding the toxicological effects of the current levels of flame retardant contamination within three vulnerable regions and allowed the evaluation of spatial trends, age and species differences, temporal trends, and tissue partitioning [9,10].

Results

Nine marine mammal species were used to obtain blower samples: grey seals (Halichoerus grypus), harbor seals, ringed seals (Pusa hispida), harbor porpoises (Phocoena phocoena), white-sided dolphins (Lagenorhynchus acutus), white-beaked dolphins (Lagenorhynchus albirostris), minke whales (Balaenoptera acutorostrata), long-finned pilot whales (Globicephala melas), grey seals, and humpback whales (Megaptera novaeangliae).

Discussion

The NW Atlantic had the highest concentrations of PBDEs, followed by the Baltic and the Arctic. This is likely due to the fact that North America has historically used more PBDEs than Europe,

***Corresponding author:** Malene Bergose, Department of Environmental sciences, Jimma University, Ethiopia, E-mail: malene39b@hotmail.com

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and that North America and the Baltic countries have become more industrialized than the Arctic. Other compounds exhibited more intricate regional patterns, with notable interactions between species, regions, body condition, and age class. The distribution of these compounds is influenced by factors other than lipid dynamics, as evidenced by the similar lipid-normalized PBDE concentrations in the liver and blubber of harbor seals, but higher concentrations of HBBZ and many Dechloranes. The possible health effects of this combination of compounds are alarming and need more investigation.

Conclusion

A complex mixture of legacy and alternative brominated and chlorinated flame retardants was found to be present in the bodies of all examined species from every region in this multi-species, multi-regional study of flame retardant contamination. The majority of chemicals were found in Arctic species, albeit at lower concentrations, even though their concentrations were higher near the industrialized United States and Sweden than in the Arctic.

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