Impacts of Fragrance Chemicals on the Ocean: 5 Key Scientific Studies

Synthetic fragrance chemicals, such as phthalates, polycyclic musks (e.g., galaxolide, tonalide), nitromusks, and synthetic terpenes, enter aquatic systems through wastewater discharge, atmospheric deposition, and runoff. Though designed for human pleasure or commercial purposes, these compounds persist in marine environments and have been increasingly studied for their toxicological effects on ocean life.

Scientific studies have shown that synthetic fragrance chemicals persist in the ocean environment, bioaccumulate in marine organisms, and pose risks such as endocrine disruption, inhibition of detoxification pathways, and ecological imbalance. Their presence in marine sediments, biota, and remote waters underscores the need for more stringent monitoring and regulatory controls.

Below are five key scientific studies demonstrating their impacts on the ocean.

Bioaccumulation and Toxicity in Marine Organisms

Galaxolide and Tonalide (polycyclic musks) have been shown to bioaccumulate in marine biota, including fish, mussels, and even marine mammals.

Study: Luckenbach, T., & Epel, D. (2005). Nitromusk and polycyclic musk compounds as long-term inhibitors of cellular efflux transporters. Environmental Health Perspectives, 113(1), 17–24.

Findings: Galaxolide and tonalide inhibit multixenobiotic resistance (MXR) transporters in mussel gill cells, reducing the ability of marine organisms to eliminate toxins, thereby increasing their vulnerability to pollutants.

Endocrine Disruption in Aquatic Life

Some synthetic fragrance chemicals act as endocrine disruptors, mimicking hormones and interfering with reproductive processes in aquatic organisms.

Study: Schreurs, R. H. M. M., et al. (2004). Comparison of in vitro and in vivo screening models for estrogens and estrogenic activity of wastewater and surface water. Environmental Toxicology and Chemistry, 23(1), 191–198.

Findings: Phthalates and musks in treated wastewater effluent displayed estrogenic activity, raising concerns about feminization of fish and disrupted development.

Persistent Organic Pollutants in the Ocean

Many synthetic musks are classified as persistent, bioaccumulative, and toxic substances (PBTs). They have been detected in open ocean waters, sediments, and polar regions.

Study: Peck, A. M., & Hornbuckle, K. C. (2006). Synthetic musk fragrances in Great Lakes air and water. Environmental Science & Technology, 40(3), 562–567.

Findings: Polycyclic musks are transported through the atmosphere and deposited into surface waters, including remote marine environments.

Study: Rimayi, C., et al. (2018). Contaminants of emerging concern in South African water systems. Science of the Total Environment, 627, 1008–1020.

Findings: Synthetic fragrance compounds were found in coastal water and sediment samples, suggesting long-range transport and environmental persistence.

Impact on Coral Reefs and Plankton

Although direct studies on synthetic fragrances and coral are limited, similar chemicals in personal care products (including UV filters and preservatives) are known to harm coral reefs and marine microbial communities, suggesting that fragrance ingredients could have comparable disruptive effects.

Study (related context): Danovaro, R., et al. (2008). Sunscreens cause coral bleaching by promoting viral infections. Environmental Health Perspectives, 116(4), 441–447.

Implication: Synthetic chemicals used in personal care formulations, including fragrances, may contribute to microbial shifts and coral stress.

Fragranced Wastewater and Marine Life Exposure

Fragrance chemicals often pass through wastewater treatment plants unchanged or only partially degraded, entering the ocean where they are taken up by marine life.

Study: Heberer, T. (2002). Occurrence, fate, and removal of pharmaceutical residues in the aquatic environment: a review of recent research data. Toxicology Letters, 131(1–2), 5–17.

Findings: Many fragrance chemicals, especially synthetic musks, resist degradation and persist in effluents discharged into rivers and coastal waters.