PFAS: State of the Science

About PFAS

Per- and Polyfluoroalkyl substances (PFAS) are chemical compounds used in a wide range of everyday products - rain jackets, winter gloves, bed linens, carpets, food packaging, footwear, non-stick pots and pans, even toothpaste and dental floss. Since their development in the 1940s, PFAS have been applied to products for non-stick, water-resistant and grease-resistant applications. PFAS are also used extensively in firefighting foam, with decades of consistent use at military bases, airports, and petroleum refineries leaving lasting concentrations of these “forever chemicals.” PFAS have been found in all parts of the environment, from soil, water and air to fish and wildlife, and from the Great Lakes to the Antarctic.

Many PFAS compounds are persistent, bioaccumulative, and toxic, posing several potential health risks. Two “long-chain" PFAS compounds in particular – PFOA and PFOS – stand out as the most highly scrutinized by medical researchers. While the science around safe levels of exposure to PFAS continues to develop, a growing body of research documents a relationship between these chemicals and higher levels of cancer, liver disease and thyroid damage.

As scientific understanding of PFAS’ health impacts and exposure pathways continues to develop, scientists are still working to better understand the health risks associated with this family of chemicals and the specific impacts of individual PFAS. As more than 9,000 PFAS have been identified, most research has focused on roughly a dozen chemicals, among them PFOS, PFOA, PFNA, PFHxS and GenX. Assessments on exposure risks through different vectors at various concentrations are also debated among researchers. Concerning exposure to PFAS through fish consumption, some studies have shown varying levels of bioaccumulation in fish tissue, but more inquiry is needed to understand the bioavailability of different PFAS present in various fish species. ASA calls for further research on these emerging contaminants, and will continue to update this page with new information as it becomes available.

Research on Impacts of PFAS to Human Health

Current scientific research suggests that considerable levels of exposure to some PFAS may lead to adverse health outcomes. While research is still ongoing to determine how different thresholds of exposure to different PFAS lead to different health effects, connections between PFAS concentrations and health impacts has been documented – particularly for “long-chain” PFAS like PFOA and PFOS.

It is important to note that most human exposure to PFAS comes from drinking water and food consumption, not from textiles or other consumer products treated with PFAS. Likewise, environmental concentrations of PFAS are largely driven by discharge associated with chemical manufacturing and production, as well as the concentrated use of soluble products containing PFAS, such as firefighting foam. Consumer goods are not the principal sources of human exposure or environmental contamination.

Learn more:

- EPA - Our Current Understanding of the Human Health and Environmental Risks of PFAS
- CDC - Toxicological Profile for Perfluoroalkyls

Exposure Pathways & Recreational Fishing

Per the National Institute of Health, the most common human exposures to PFAS come from "consuming PFAS-contaminated water or food, using products made with PFAS, or breathing air containing PFAS," though research on exposure pathways remains ongoing.

Research indicates that many PFAS, including long-chain PFAS, are bioaccumulative, and some studies link regular consumption of certain recreationally-caught freshwater fish with higher blood concentrations of some PFAS. On the whole, based on research to date, freshwater fish tend to carry higher concentrations of PFAS than marine fish, and native and naturally-reproducing fish maintain higher concentrations than stocked fish. However, it is important to note that these are general trends based on research to date. No nation-wide comprehensive examination of PFAS across all fish and all waterbodies has been conducted. In other words, while consumption of certain fish in certain areas may create elevated risk of PFAS exposure in humans, other fish in other areas may not.

Some states have published fish consumption advisories (example) and extended more information on PFAS (example), aiming to reduce exposure to PFAS through recreational and subsistence anglers' consumption. More information is needed to determine risk thresholds for exposure through fish consumption, as well as information on PFAS concentrations in various freshwater fish species in the US.

Learn more:

- Assessing exposures to PFAS in two populations of Great Lakes Basin fish consumers
- Assessing per- and polyfluoroalkyl substances (PFAS) in sediments and fishes in a large, urbanized estuary and the potential human health implications
- Consumption of freshwater fish: A variable but significant risk factor for PFOS exposure
- Is freshwater fish consumption a significant determinant of exposure to PFAS?

PFAS Impacts on Fish Health

Compared to inquiries on human health, less research has yet explored the impacts of PFAS on fish and wildlife health. Individual studies on fish species in specific watersheds have observed differing effects. Studies have linked PFAS with changes in gene expression in Minnesota largemouth bass, as well as with irregular swimming behavior by bluegill. Further research into this field is needed to determine the impacts of different PFAS on sportfish and aquatic organisms.

Learn more:

- The effects of exposure to environmentally relevant PFAS concentrations for aquatic organisms at different consumer trophic levels: Systematic review and meta-analyses
- Bioaccumulation and trophic magnification of emerging and legacy PFAS in a St. Lawrence River food web
- Molecular impacts of PFAS in the liver and testis of male largemouth bass in Minnesota Lakes
- PFAS in Plasma of Smallmouth Bass from the Chesapeake Bay Watershed
- Impacts of Exposure to PFAS-Contaminated Groundwater on Reproductive Biomarkers in Fathead Minnow
- PFAS in surface water and Bluegill and its relationship to swimming performance