Marine Conservation Society position statement on:

PFAS 'forever chemicals'

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Geographical extent: UK
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The Marine Conservation Society view

PFAS 'forever chemicals' are a threat to the health of the marine environment because of their high persistence and high mobility in water. We believe the precautionary principle is vital for PFAS; there are thousands of different chemicals in this group and achieving scientific certainty of all their harmful effects is not feasible or practical and instead delays comprehensive action on PFAS by thousands of years. We must urgently stop the use and pollution of PFAS to properly protect humans, wildlife and the wider environment.

The Marine Conservation Society asks

- For the UK Government to introduce a Universal PFAS restriction (by 2030). We need a comprehensive ban on PFAS due to the wide number of different consumer and industrial uses.
- For the UK Government to immediately ban PFAS in consumer products, firefighting foams and other uses where there are known alternatives (by 2026).
- For businesses to identify PFAS use in their business and support our calls for a ban (ongoing).
- For individuals to support our call for a ban (ongoing). PFAS are in so many products, they are often impossible to avoid, therefore we urgently need a ban.

What the Marine Conservation Society is doing

- Conducting our own research on PFAS in the marine environment.
- Campaigning to increase awareness and support for a PFAS ban.
- Working with other NGOs like CHEM Trust, Fidra and Breast Cancer UK to call for action.
- Working with businesses to raise awareness of PFAS that may be present in their supply chains.
- Meeting with ministers, decision makers and regulators to present our evidence, and that of scientists around the UK, including presenting the solution to the PFAS problem.

Background

PFAS (Per- and polyfluoroalkyl substances) are a family of several thousand similar chemicals, often called 'forever chemicals' due to their resistance to degradation in the environment, making them very persistent.[1] PFAS are often characterised by the length of their carbon atom chains, and it is these carbon atoms bonded to fluorine atoms that create the incredibly strong bonds which makes them so persistent. Persistence is a characteristic of chemicals that have a degradation half-life of more than 60 days in marine water; 40 days in fresh/estuarine water; 180 days in marine sediment; or 120 days in fresh/estuarine water or soil.[2] A "half-life" is the time it takes for the concentration of a chemical to reduce by half.

PFAS can withstand degradation by heat, water, oil, Ultra-Violet (UV) light and chemicals, making them useful in a wide range of different applications.[3] They are used in food packaging, waterproof clothing, non-stick cookware, firefighting foams and numerous industrial uses.[4] A more comprehensive list of applications and functions can be found in *Appendix A*.

Short chain vs. long chain
Often PFAS are grouped into short-chain or long chain, in reference to the length of their specific carbon chain. Concern was initially on long-chain PFAS like PFOS and PFOA (two individual PFAS, both eight carbon atoms long) because they have a higher tendency to bioaccumulate.[11] Short-chain PFAS were considered 'safer' alternatives because of their low-bioaccumulation and their supposed low toxicity. Research has now established that Trifluoroacetic acid, or TFA (the shortest chain PFAS) concentrations are orders of magnitude above other PFAS in the environment and they have been linked to several impacts of their own.[12]

PFAS are also highly mobile in water, due to their solubility, meaning they can travel vast distances from their source.1 This has led to them being found in remote regions, miles from manufacture, use or disposal. This high mobility is the primary reason for them being present in water all over the world. PFAS are in seas,[5] lakes,[6] rivers,[6] rainwater,[7] drinking water,[8] arctic ice[9] and even concentrated in sea-spray.[10]

It has been established by researchers in Stockholm that PFAS have exceeded the safe operating space in the planetary boundaries model for novel entities because of their wide-spread irreversible pollution, which is because of their high persistence and mobility.[7]

PFAS have multiple routes into the environment, both direct and indirect. Firefighting foam is one of the biggest direct sources of PFAS into the environment and contributes largely to several of the 'high risk sites for PFAS' identified by the Environment Agency.[13] PFAS are also able to enter the environment from landfill leachate[14] when products containing PFAS are disposed at the end of their life. The most prolific route of emissions for PFAS is through air pollution from the degradation of F-gases (fluorinated gases) used as replacement refrigerants.[15]

Finally, PFAS can enter the environment from wastewater treatment works. Our research with the University of Portsmouth showed an increase in levels of PFAS in the water in a protected harbour shortly after a sewage discharge.[16] This research also demonstrated high levels of PFAS in seaweed in the same harbour. Furthermore, PFAS have been shown to be present in sewage sludge spread on land and in treated wastewater effluent.[17]

Impacts

PFAS have been found in wildlife all around the world, in everything from plankton,[18] the building blocks of the ecosystem, to apex predators at the top of the food chain like polar bears[19] and whales.[20] The Marine Conservation Society, Watershed Investigations and The Guardian published a map of data of PFAS in wildlife around the UK,[21] the species included in the map are harbour porpoises, buzzards, northern gannets, foxes, fish and otters. This data is not an exhaustive list of wildlife affected by PFAS, but rather the data that was available at the time. It does, however, show the spread of PFAS across the taxa and across marine, freshwater and terrestrial environments.

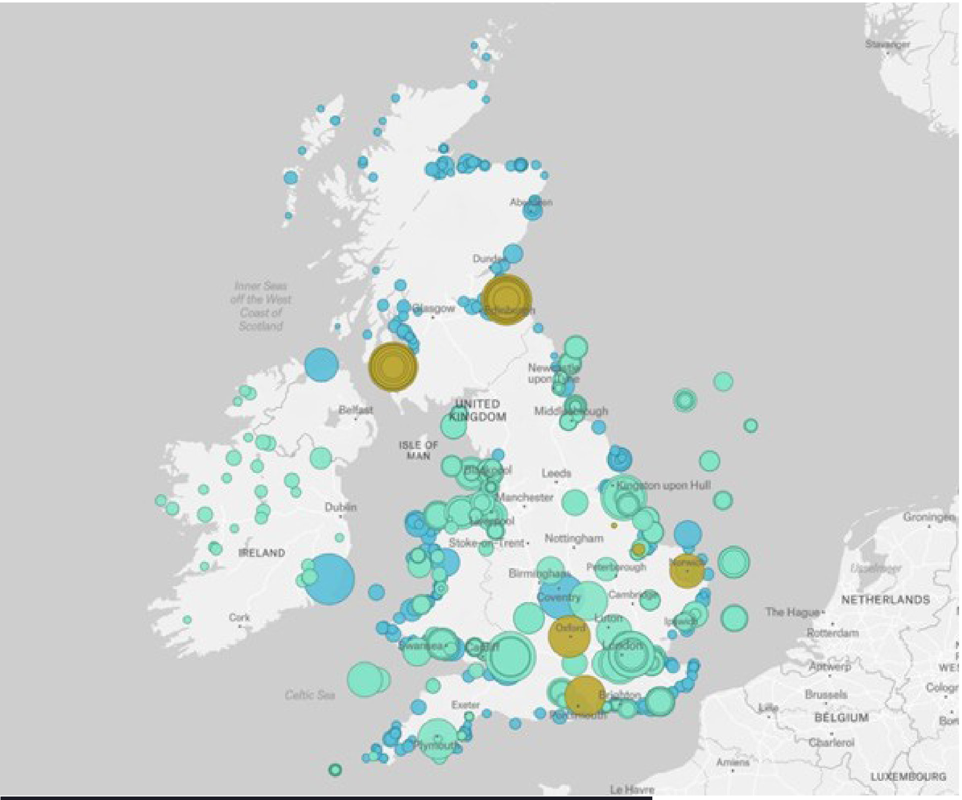

Figure 1: Watershed Investigations pollution map showing only the UK animal data.[21]

Research into PFAS impacts has been weighted primarily on PFOS and PFOA, with many of the reported impacts of PFAS being specifically from PFOS and PFOA. Many impacts from PFAS are long term chronic effects that build up over time. For example, these chemicals have been linked to:

Impacts on immune function:

- Southern sea otters collected off the coast of California were found to have significantly higher levels of PFOS and PFOA in animals that had died from infectious disease compared to those that had died of other causes.[22]
- PFOS was found to directly dysregulate the immune system of bottlenose dolphins in a study conducted over several years in the USA.[23]
- Striped bass were shown to have altered immune function related to elevated PFAS levels.[24]

- PFAS have been shown to alter immune function in alligators resulting in autoimmune type reaction.[25]

- PFAS have also been shown to have impacts on vaccine efficacy in humans ultimately impacting immunity.[26]

Hormonal effects:

- PFAS were shown to impact thyroid hormones in seabirds.[27]

- PFOA was found to disrupt thyroid hormones in zebrafish larvae.[28]

Alternatives to PFAS
In short, there are viable alternatives for many uses of PFAS, including for several consumer products and firefighting foams. Ongoing research is continually finding further alternatives. (See our more in depth briefing on alternatives to PFAS here).

Neurological impacts

- PFOS and PFOA have been found to significantly decrease dopamine in the brain of Northern leopard frogs.[29]

- Polar bears were also found to have neurological impacts from PFAS exposure, potentially affecting their movements and behaviour.[30]

Other impacts

- PFAS were shown to cause liver damage in black-spotted frogs.[31]

- Freshwater turtle hatchling deformities were more common in PFAS contaminated sites than non-contaminated sites.[32]

PFAS have been shown to pass from mother to young in several species, including crossing the placenta in mammals[33] and passing into eggs of seabirds[34] and freshwater turtles.[32] This means young are being polluted before they are born, altering their immunity, development or chances of survival going forward.

More recently there has been growing evidence on the impacts of the shorter chain PFAS chemical including TFA, the shortest PFAS. TFA is now the most abundant PFAS worldwide, as it is often the terminal degradation product of other PFAS, and F-gases used as refrigerants.[12] TFA has been shown to impact foetal development in rabbits, and links to human reproduction have been suggested.[12] TFA has also been shown to be toxic to rat livers.[12]

Our study with the University of Portsmouth published in 2024 also showed the accumulation of PFBA, another short-chain PFAS, in seaweed in Langstone harbour. PFBA had accumulated in samples of bladder wrack at 6000 x the surrounding water,[16] suggesting that algal material like seaweed is a potential route for short-chain PFAS into the rest of the food chain.

Puffin
Kevin Morgans

Bladder wrack
MCS

Relevant legislation

UK REACH (Registration, Evaluation, Authorisation and restriction of CHemicals) is the UK's primary chemical legislation.[35] After exiting the EU, the UK took the same system (REACH) that was present in the EU. However, since then, the UK has not kept pace with restrictions that have been implemented in EU REACH, ultimately affording lower protections to UK citizens and wildlife.[36]

At the time of writing this paper, only a handful of different PFAS have been restricted in the UK either through the Global Stockholm Convention (PFOS, PFOA and PFHxS)[37] or through REACH prior to leaving the EU. There are estimated to be thousands of different PFAS, with hundreds in commercial use currently, therefore there is an urgent need to introduce a group restriction on PFAS in their entirety, rather than substance-by-substance restrictions.

A note on definitions
When referring to PFAS we are specifically referring to the OECD (Organisation for Economic Cooperation and Development) definition.38 This is a scientific definition of PFAS, not one driven by policy or economics and is universally recognised. A recent statement from scientists around the world explains the importance of using the OECD definition.[39]

Food packaging uses PFAS for anti-stick and waterproofing
Shutterstock / ViDCan

In June 2025 the UK Government published a position statement regarding the PMT approach to managing PFAS.[2] PMT refers to Persistent, Mobile and Toxic and vPvM (very persistent and very mobile) also falls under this approach. This approach takes a broader outlook on chemicals by looking at the characteristics that often result in environmental and human health problems in the long term. We welcome this approach, but it needs to be accompanied by action.

Several countries around the world have introduced their own PFAS legislation, for example:

- The EU has committed to a Universal PFAS restriction which was a proposal submitted by Denmark, Germany, the Netherlands, Norway and Sweden, to restrict the import, manufacture and use of over 10,000 different PFAS.[40] Since the EU commitment, Denmark[41] and France[42] have implemented their own individual consumer product bans focusing on paper and card food packaging; clothing; footwear and cosmetics; clothing and ski wax.

- In the USA, individual states including Maine, Colorado, California and Vermont, among others, have implemented their own restrictions on PFAS in consumer products and firefighting foams.[43]

- In 2023 the Canadian federal government published a draft state of PFAS report, in which they indicated that it was impractical to manage PFAS as individual substances.[44]

- In 2024, Japan also published a proposal to designate 138 PFAS as Class I Specified Chemical Substances, which would completely prohibit the manufacture, import and use of these chemicals.[45]

Appendix A - uses of PFAS

*This list is not intended to be exhaustive but provides a more comprehensive list of the type of applications for PFAS.[4]

Sector/product	Function
Cookware	Anti-stick, waterproofing, heat stabilising and corrosion inhibiting
Food and feedstock packaging	Anti-stick and waterproofing
Firefighting foams	Surfactant
Waxes and polishes	Waterproofing
Electrical cables and wires	Heat stabilising, flame retardant and corrosion inhibiting
Toner and printer inks	Wetting agent and waterproofing
Musical instruments	Lubrication
Ski wax	Wetting agent
Cosmetics and makeup	Filler, conditioning, solvent, surfactant, binder and viscosity controlling
Refrigeration and heat pumps	Heat transferring agent
Pesticides	Active substances and wetting agents
Pharmaceuticals	Active substances
Medical applications e.g. catheters, wound treatment, measured dose devices, hospital gowns	Waterproofing, anti-stain, anti-stick, heat stabilising and corrosion inhibiting
Carpets, rugs, curtains and home furnishing	Waterproofing and anti-stain
Footwear	Waterproofing, anti-stain, anti-stick, heat stabilising and UV stabilising
Outdoor clothing	Waterproofing, heat stabilising and UV stabilising
Outdoor equipment e.g. tents and awnings	Waterproofing, anti-stick, heat stabilising, corrosion inhibiting, UV stabilising and hardening
Sportswear	Waterproofing, heat stabilising, UV stabilising and anti-stain
Automotive and transport	Heat stabilising, insulating, lubricating, corrosion inhibiting and waterproofing
Lubricants used in multiple industrial uses	Lubricating agent, corrosion inhibiting, anti-stick, viscosity control, heat stabilising and insulating
Oil and gas	Surfactant, foamant, heat stabilising, flame retardant, viscosity control and lubricating
Plastic & chemical production	Heat stabilising, wetting agent, foamant, defoamer and waterproofing
Green energy sector- solar panels and wind turbines	Waterproofing, anti-stick, UV stabilising, heat stabilising, binding, hardening and corrosion inhibiting
Wastewater treatment	Lubricating and corrosion inhibiting

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