GREENPEACE

# UPSTREAM:
## MICROPLASTICS IN UK RIVERS

# WHAT WE FOUND

1. A widespread Greenpeace survey of 13 UK rivers has found that they all contain plastic pollution. In the first nationwide exercise of its kind, our scientists found microplastics (items measuring less than 5mm) in 28 out of 30 locations tested.

2. A total of 1,271 pieces of plastic – ranging in size from straw and bottle-top fragments to tiny microbeads less than 1mm across – were captured in a specially designed net.

3. The highest concentration of plastics found was in the River Mersey. In just half an hour, 875 pieces were captured. This made the Mersey, at the time sampled, proportionately more polluted than the infamous Great Pacific Garbage Patch.

4. Microbeads – tiny plastic spheres often used in cosmetics and household products – were found in five of the 13 rivers. Samples from the Mersey contained 36 plastic microbeads despite them having been partially banned in 2017.

5. Samples from seven locations contained plastic pellets called 'nurdles', which are used as a raw material in the production of plastic products. Again, the most contaminated sample was from the Mersey, where 79 nurdles were captured close to a plant that mass-produces the pellets.

6. More than 80% of the polymer types we found were polyethylene, polystyrene and polypropylene. These are used to make a wide variety of plastic products such as food packaging, milk and water bottles as well as carrier bags.

We sampled rivers across England, Wales, Scotland and Northern Ireland – the Exe, Thames, Severn, Great Ouse, Trent, Mersey, Aire, Derwent, Wear, Conwy, Wye, Clyde and Lagan.

Wildlife and plastic waste, including single-use plastic, found on the River Lea, 15 Feb 2019.

# THE RIVERS WE TESTED

# MICROPLASTICS IN RIVERS

Common kingfisher perched on discarded litter near Deptford Creek, London, 27 Sept 2013.

International concern over plastic polluting the oceans has grown exponentially over the past two years. Reports of huge ocean garbage patches and images of seabirds feeding plastic to their chicks, or dead whales washing up on beaches – their stomachs full of plastic bags – are ubiquitous in the world's media.

Less attention, however, has been paid to levels and toxicity of plastic in UK rivers, even though an estimated 80% of plastic pollution found in oceans begins its journey in inland waterways – from urban landfill and sewage sludge run-off, industrial activity, waste treatment plants and littering. The remaining 20% originates from sea-based activity such as fishing and dumping from ships (Li *et al.*, 2018).

Rivers flow surely to the sea, and scientists believe as many as 60 billion pieces of plastic are discharged into oceans from rivers worldwide each day (GESAMP, 2016). In spite of this, academic studies into microplastics in freshwater systems have received far less attention than plastics in oceans and they remain woefully understudied to date.

Research into the levels and effects of plastic in rivers has begun to accelerate in recent years, but there are still many fundamental gaps in scientific understanding of the distribution, complexity and impacts of plastics as contaminants in freshwater ecosystems. Given that the cause of most ocean pollution is to be found upstream, understanding the ways in which rivers





contribute to the transfer and concentration of plastics, including microplastics, is of crucial importance. Furthermore, it is vital to recognise that waterways are not simply conduits that carry water, sediments and associated pollutants to the coast, but that they are also complex and fragile ecosystems in their own right and they need our protection.

In the UK, limited studies in recent years have found evidence of macro and microplastics in rivers including the Thames, Mersey, Trent, Tamar, Usk, Taff and Wye (Horton *et al.* 2017; Tibbets *et al.* 2018; Hurley *et al.* 2018; Morrit *et al.* 2014; Kay *et al.* 2018; Sadri & Thompson 2014; Gallagher *et al.* 2015).

In order to expand upon this work, during February and March 2019 Greenpeace UK conducted what we believe to be the most geographically widespread survey to date of plastic pollution in the surface waters of British rivers, by using a specially designed floating 'manta' net to collect samples from 30 locations along 13 different rivers – nine in England, two in Wales, one in Scotland and one in Northern Ireland.

Our findings provide an original, unique and worrying insight into the diversity and spread of plastic pollution in the UK's waterways.

Top: A brown trout swims next to a plastic bottle in the River Derwent in Derbyshire, a tributary of the River Trent, 25 Feb, 2019.
Middle: An otter is photographed next to a plastic bottle at the Little Ouse river in Norfolk, 31 October 2018.
Bottom: A coot sits on a nest built with plastic in the River Lea, 13 May 2019.

# HOW WE DID IT

## THE RIVERS WE TESTED

We sampled the Exe, Thames, Severn, Great Ouse, Trent, Mersey, Aire, Derwent, Wear, Conwy, Wye, Clyde and Lagan.

## HOW WE DID IT

Researchers, volunteers and scientists collected samples for laboratory analysis from river surface water at 30 locations across 13 river systems between 6 February and 29 March 2019. Rivers were selected to include both rural and urban locations, and samples were collected far enough upriver to ensure no plastic debris had come from the sea during high tides.

We collected the samples using a manta net, a specialised piece of equipment resembling a manta ray, with two buoyant 'wings' and a large rectangular 'mouth' connecting to a net where the debris collects. Its mouth measures 30cm x 15cm and the size of the mesh was the same as that used in numerous studies elsewhere in the world: 0.33mm.

The manta net was secured either to the riverbed by anchor or to an overhead footbridge for periods of time which varied depending on the rate of flow of the river and to avoid the net becoming overfilled and clogged. At the end of each sampling period, the net was retrieved and the contents taken to the Greenpeace Research Laboratories at the University of Exeter. Here, the collected plastic items were divided into four sizes: macroplastics measuring more than 5mm in at least one dimension, microplastics of between 5mm and 2mm and between 2mm and 0.3mm in size, and microfibres less than 1mm in diameter, though of varying lengths. They were then subjected to rigorous analysis.



**Top L-R:** The manta net in operation on the River Severn, 4 Mar 2019. ©Rose/Greenpeace.
Greenpeace team samples the waters of the River Clyde, 27 Mar 2019. ©Sutton-Hibbert/Greenpeace.
The field team preparing to test from a footbridge on the River Mersey, 19 Mar 2019. ©Morgan/Greenpeace.
**Middle L-R**: Sample from the River Clyde in a glass jar, 27 Mar 2019. ©Sutton-Hibbert/Greenpeace.
Fiona Nicholls, Greenpeace campaigner (right) and wildlife biologist Kirsten Thompson (left) inspect a sample taken from the River Clyde, 27 Mar 2019. ©Sutton-Hibbert/Greenpeace.
**Bottom:** Hollywood actor Bonnie Wright joins scientists and campaigners to investigate plastic pollution in the River Wye, 5 Mar 2019. ©Rose/Greenpeace.

# FINDINGS

### OVERALL

We found plastic in every river we tested across the UK.

At least one piece was found at 28 of the 30 locations sampled. In total, 1,271 pieces of plastic were captured, ranging in size from plastic straw and bottle-top fragments to microbeads measuring less than 1mm across.

The study's findings reflect plastic contamination of rivers based on a snapshot in time. The most contaminated river in the study was the Mersey, with a total of 942 pieces across both samples. Using the same measure other studies have used (described below), if we were to extrapolate our findings for the Mersey, we would find it contains more than 2 million pieces of microplastic per square kilometre, a number higher than that found at the infamous Great Pacific Garbage Patch that accumulates within the North Pacific Gyre (Moore *et al.* 2001, found a maximum of 334,271 pieces per square kilometre; Law *et al.* 2014, found more than 1 million pieces per square kilometre).

Many of the other rivers in the study also revealed high levels of plastic contamination. The Thames samples contained a total of 108 pieces of plastic, the Aire revealed 63 in total, the Severn contained 42 pieces and the Trent samples had 35 pieces. The Exe samples contained 23 pieces of microplastic in total, the Lagan had 12, the Clyde 11, the Derwent and Wye both had 10, the Wear had five and the Great Ouse contained one.

During the time we took samples, two out of 30 revealed no plastic; these locations were relatively rural sites on the Conwy and Great Ouse.

### SIZES, TYPES AND KINDS OF PLASTIC POLLUTION FOUND

Plastic fragments and microbeads less than 2mm in size were the most commonly found (517 pieces), closely followed by fragments and pellets between 2mm and 5mm in size (505 pieces). In total, 170 fragments or pellets of plastic with at least one dimension greater than 5mm were recovered. We also found 80 plastic fibres of varying widths and lengths.

More than 80% of all the plastic items recovered fell into three polymer types – Polyethylene (PE), polystyrene (PS) and polypropylene (PP). These are the types most widely used for 'disposable' single-use packaging. Smaller amounts of a further 12 polymer types were also identified, including ethylene-vinyl acetate (EVA), polyvinyl chloride (PVC), polyethylene terephthalate (PET) and polyamide (PA).

## MACROPLASTICS

**>5MM**

**Diameter or length that is greater than 5mm**

## MICROPLASTICS

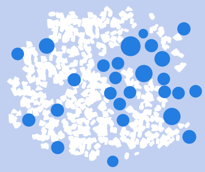
**<5MM**

**Diameter or length that is up to and including 5mm**

**Can be divided into:**

**PRIMARY MICROPLASTICS**

**Plastic particles that were manufactured to be a particular size, eg microbeads, nurdles**



**SECONDARY MICROPLASTICS**

**Pieces of plastic that have been degraded from a large item, eg plastic bottle to a smaller size**

## NANOPLASTICS

**< 1UM**

**Considered a subset of microplastics**

**Diameter or length that is smaller than 1um**

There is currently no formal size definition for microplastics. For the purposes of this report we have adopted the measurements in the GESAMP (2015) report, which states that microplastics are considered to be in the size range 1um to 5mm.


Plastic sample from the River Mersey, showing a microplastic particle being separated from organic material at Greenpeace Research Laboratories, 17 Apr 2019.

Of the three main polymers found, polyethylene was the most common, amounting to 46% of all plastic items. It was found in irregular coloured fragments, sections of transparent or coloured film (such as that used in food packaging), microbeads of the type formerly permitted for use in toothpastes, shower gels and other personal care products, 'nurdles' (plastic pre-production pellets) and 'biobead' pellets, which are used to provide surfaces for bacterial and fungal growth at wastewater treatment plants. Polyethylene is used in a wide variety of products, including milk bottles, household cleaning products and a huge range of containers for consumer and industrial use.

Two samples each from the Mersey and the Aire contained expanded polystyrene beads (which are commonly used in packaging, notoriously brittle and difficult to recycle). In the most contaminated Mersey sample, 127 were captured while 18 were found in the second Mersey sample. The Aire samples contained one and five polystyrene beads respectively.

Among the macroplastic items found in the manta nets (ie more than 5mm in at least one dimension) were clear and coloured pieces of film or foil (in the Thames, Severn, Mersey and Derwent); PVC cable sheathing (Thames); part of a bottle cap, packing strap, strimmer line, plastic straw and ring (Mersey); and clothing tag debris (Wye).

Another conspicuous type of plastic pellets, more cylindrical in shape and about 5mm in length, were identified as 'biobeads', or plastic pellets that are used in water treatment works to provide surfaces for micro-organism growth. These were found in samples from four of the locations – the two from the Mersey (containing 59 and two biobeads respectively), one sample from the Severn (two biobeads) and one sample from the Aire (12 biobeads).

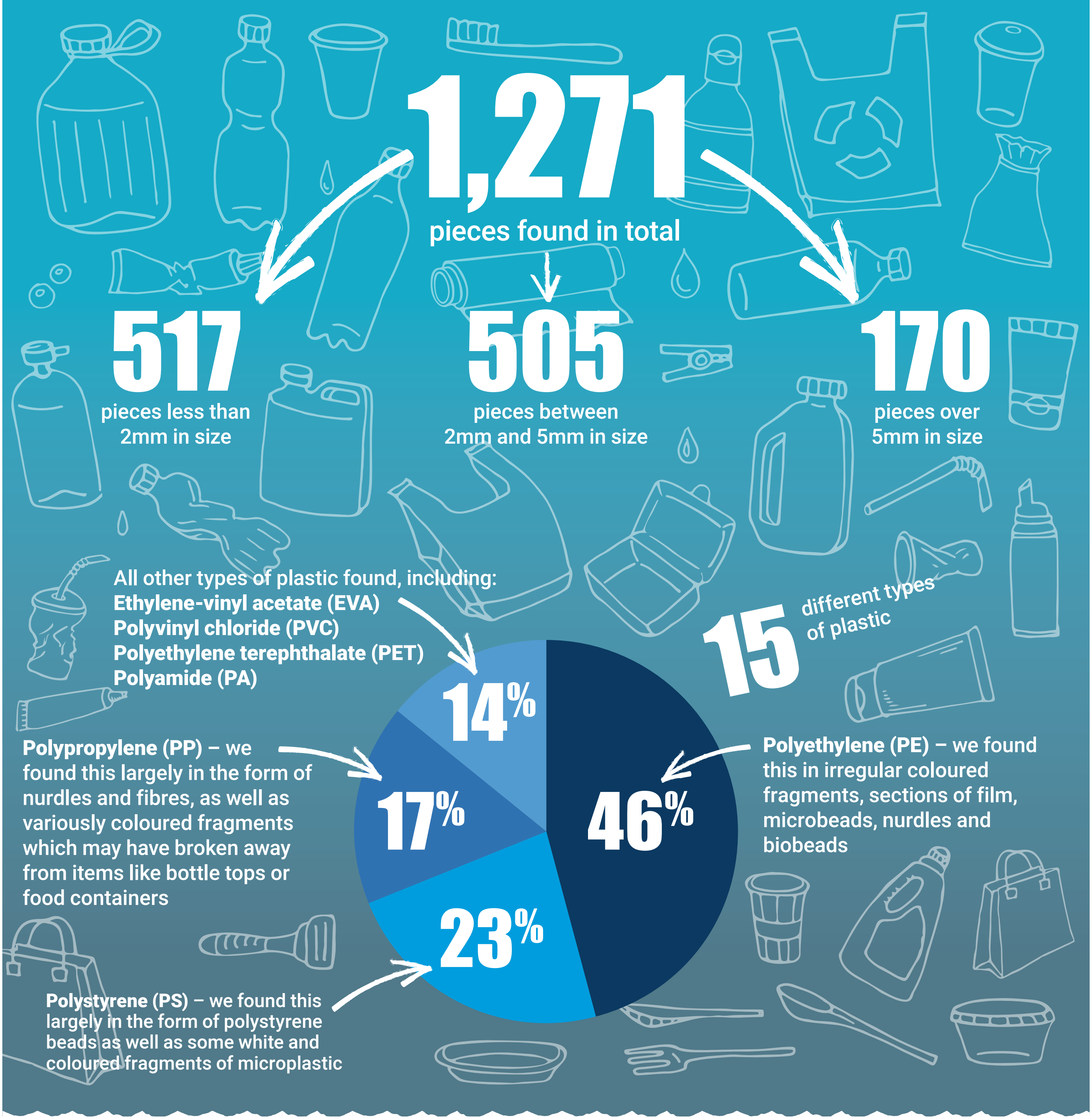
Given their use in water treatment plants, and the evidence that some are made from relatively low grades of recycled plastic (Turner *et al.* 2019), biobeads may be expected to carry particularly high burdens of chemical (as well as biological) contaminants.

## COMPARATIVE STUDIES

This study presents a 'snapshot' of pollution levels on the days and in the stretches of river we sampled. Given a variety of weather conditions, differing days or times of sampling, or the duration of testing, the results in each river could have been very different. Longer-term sampling would be necessary to establish more fully the extent to which each waterway is polluted by plastics.

Nonetheless, taking the sample set from this study, it is possible to compare the overall results with those reported by other studies. In the few studies to date that have quantified plastic contamination of surface river water, most express their data in terms of number of total plastics and microplastics per cubic metre of water.

Nurdles, biobeads, polystyrene balls and other microplastics from the River Mersey. ©Hyde/Greenpeace.


On that basis – and assuming our net was routinely sampling to a depth of 10cm – the estimated average number of pieces of plastic across our 27 samples was 1.293 pieces per square metre (median 0.129 pieces per square metre, maximum at one of the two sites on the Mersey at 27.35 pieces per square metre).

Using similar net systems, Sadri & Thompson (2014) recorded an average of 0.028 plastic pieces per square metre in the River Tamar in the south-west of England, lower than the median value in our study.

However, another UK study found levels slightly higher than our median value. This examined levels of plastics in the surface estuarine waters of three rivers flowing into the Solent in Southampton and expressed the data in terms of number of plastic pieces per square metre, ie surface area sampled rather than total volume swept (Gallagher *et al.* 2015). On this basis, the average values for those estuaries (between 0.4 and 5.86 pieces per square metre) are slightly higher than the average values determined from our findings (0.129 total pieces of plastic per square metre, 0.108 microplastics per square metre).

# WILDLIFE IMPACTS

Scientists believe that as many as 1 million species are facing extinction (IPBES 2019) due to the pressures on nature from climate change and rising levels of pollution. The impact of large pieces of plastic litter on marine life – through entanglement, choking and strangulation – has been well documented. Less well known is the extensive research that demonstrates how microplastics can be ingested by marine life and cause problems because of their presence in the gut and the chemical contaminants they carry.

When mistaken for food and eaten by marine species, microplastics have been shown to cause gut blockage and physical injury, alter feeding behaviour and affect energy levels, growth rates and reproduction (Greenpeace 2016). For instance, microplastic ingestion has been found to decrease energy reserves and reduce feeding activity in marine worms, a keystone species inhabiting intertidal sediments in Northern Europe (Wright *et al.* 2013).

We also know that microplastics can take on and leach out chemicals, and that as a result these chemicals can end up in the tissues of marine species. For instance, fish exposed to polyethylene microplastics with pollutants sorbed from the marine environment accumulated the pollutants and suffered liver toxicity (Rochman *et al.* 2013).

A water vole and single-use coffee cup lid at the River Derwent, Derbyshire, 30 Apr 2019.



A mute swan is photographed underwater next to a plastic bag in the River Trent, 25 Feb 2019.

During our campaign we witnessed voles eating plastic and swans using it to build their nests.


A caddisfly larva with plastic incorpoated into its protective case in the River Tame, Birmingham, 2 May 2019.

Very limited research has been done into the impact of macro-plastics on river wildlife – though during our campaign we witnessed voles eating plastic and swans using it to build their nests. Even less data exists on the levels and impacts of microplastic ingestion by river species such as fish, otters and swans. However, we can anticipate that microplastics could have a similar impact on river species to ocean species.

Among the clearest evidence to date that freshwater species are exposed directly to microplastic pollutants is provided by the work of Windsor *et al.* (2019), who recently documented the presence of microplastics in the guts or other tissues of several species of invertebrates (including insect larvae) collected at locations along the rivers Usk, Taff and Wye in South Wales.

These findings raise the possibility that those ingested microplastics may subsequently be transferred up through the food web to predators such as fish and birds, though this remains to be confirmed. At the same time, recent laboratory studies on mosquito larvae have suggested that there are mechanisms by which microplastics taken up by aquatic larval stages of insects may even be carried over through pupation into adult insect tissues and thereby distributed from one river system to another (Al-Jaibachi *et al.* 2018).

Further studies of exposure to, and physiological effects of, microplastics within aquatic species are needed as a matter of some urgency. Meanwhile, it is important to recognise that plastics of all forms entering rivers today are likely to persist for some considerable time in the environment and may be irretrievable.


A common frog sitting among plastic in the Grantham Canal, 10 May, 2019


A coot and its chick are pictured with plastic in the River Lea, 12 May 2019.

## CASE STUDY – NURDLES IN THE MERSEY

Nearly all plastic we encounter from day to day begin life as a nurdle, a small, lentil-sized plastic pellet that can be melted, coloured and moulded into any shape a manufacturer desires. Billions are used by the plastics industry every year, but mishandling and mishaps in transit mean that increasing numbers of nurdles are ending up at sea and in our rivers.

According to the British Plastics Federation, there are 5,200 plastics manufacturers in the UK producing 1.7 million tonnes of raw plastic each year. Nurdle manufacturers such as Basell Polyolefins cannot keep pace with demand, and so a shortfall of 2.3 million tonnes is imported by sea each year from around the world, increasingly from the Middle East and Asia.

Each tonne of plastic is made of 50 million nurdles (Cole *et al.* 2016), and bulk trucks carry around 2 billion nurdles per load (United States EPA 1992). Nurdles pose a significant threat to the environment when mismanaged. Once spilt, they can be lost down drains around the factory building and carried out to sea (United States EPA 1992).

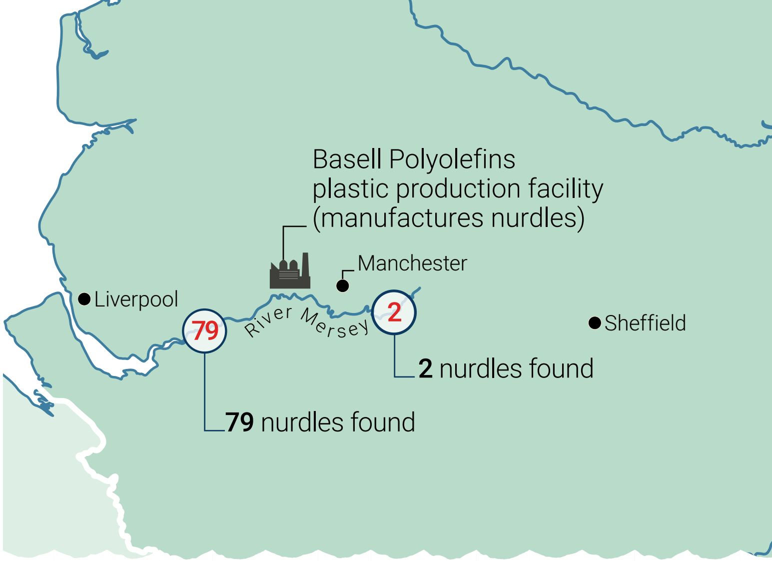
Nurdles, in common with all microplastics, can attract persistent organic pollutants (POPs), toxic synthetic chemicals such as pesticides or industrial products that can accumulate in tissue and resist degradation. These chemicals can accumulate on the surface of nurdles, and as the pellets fragment into microplastic particles they can be mistaken for food by marine animals and seabirds and so enter the food web.

One of the UK's largest plastic nurdle production facilities, Basell Polyolefins UK, sits beside the River Mersey. As with the other rivers, we sampled the Mersey at two separate locations; one rural and another downstream of an urban conurbation. In the case of the Mersey these two testing sites also sat either side of Basell Polyolefins, which produces and distributes the plastic pellets. What we found was highly disturbing.

Upstream of Basell Polyolefins, we found 67 microplastic pieces (including just two nurdles). In terms of levels of plastic pollution, taking account of the different river flow rates, this figure can be considered very high and is significantly higher than the average found in most other comparable sites tested. However, what we captured downstream of Basell Polyolefins was simply staggering – 875 pieces of microplastic, including 79 nurdles, in just half an hour of sampling.

The river was more than 10 times more polluted downstream of the nurdles factory than upstream of it.

Samples from seven locations in the study contained nurdles in the size range 3-5mm in diameter. Again, the most contaminated sample was that from the Mersey (the 79 nurdles). Two other samples, one from the Mersey and one from the Thames, contained two nurdles and one was found in a sample from the Aire.


## CASE STUDY: MICROBEADS – TWO YEARS ON FROM THE BAN, WHAT IS GOING WRONG?

'Microbeads' are microplastic ingredients that are added to products such as cosmetics and toiletries, including face scrubs, toothpastes and shaving products, as well as household cleaning products such as floor cleaners and paints.

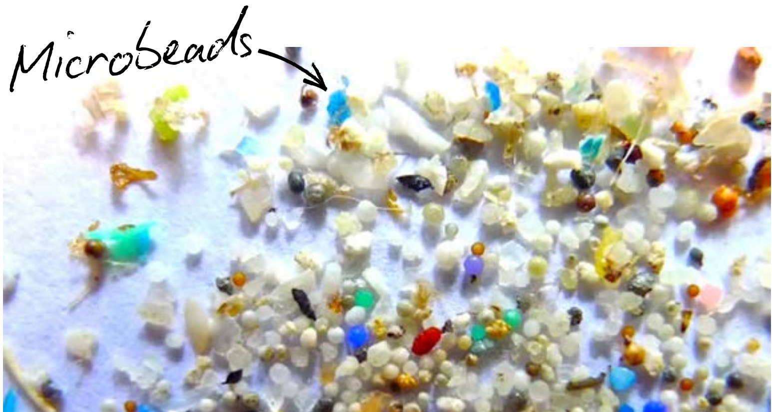
The impact of microplastics on the environment has been well documented and led to the UK Government banning the sale of products containing microbeads in January 2018. However, the ban was limited to rinse-off products and excluded some commonly used cosmetic products such as sunscreen, lipstick and household products.

The findings of this report provide clear evidence that, more than a year on from the ban, microbeads continue to enter the UK's waterways, whether as a legacy of previous use, continued use of older products or from use in products that were not covered by the ban.

Samples collected from five locations contained microbeads in the size range 0.5mm-2mm and in various colours (predominantly pink, green or blue). The most contaminated sample from the Mersey contained 36 microbeads. The two samples from the River Trent contained 10 and seven microbeads respectively. One sample from the Great Ouse and the Aire each contained one microbead.

Thi sinvestigation suggests that the current ban is failing to adequately address microbead pollution and needs to be extended to cover all products that contain microbeads.

Nurdles and other microplastics from the River Mersey. ©Hyde/Greenpeace.
Close-up image of microbeads. Image courtesy of The 5 Gyres Insitute.
For more info about the work of the institute, go to 5gyres.org



# CONCLUSIONS

1. The results of this geographically widespread 'snapshot' survey demonstrate that plastic pollution is common to **all** the rivers investigated at some level, at almost all the locations sampled, and at some locations is **already severe**. Once plastics, especially microplastics, have reached a river, it becomes increasingly difficult, if not impossible, to remove them; they have **become part of the hidden landscape of the UK's waterways**, with the potential to endanger wildlife and our own health.

2. While the use of the floating manta net provided us with a way to collect samples in a consistent and controlled manner across all the rivers we tested, by focusing on the surface 10cm of the rivers, we are undoubtedly seeing only a small proportion of the overall loading of plastics in our samples. In other words, **we are witnessing just the tip of a plastics iceberg**.

3. We have also investigated only those plastics down to a size range of around one-third of a millimetre, in common with many previous studies of microplastics both in marine and freshwater. This means we were unable to to capture efficiently the smallest sizes of microplastics or microfibres, like those known to shed from clothing.

   This is significant, as studies that have employed nets with a finer mesh, or even the filtration of whole water samples through meshes or filters of much smaller pore size, often report higher concentrations of microplastics than are recorded with manta net surveys.

4. Although we found high numbers of 'nurdles', 'biobeads', expanded polystyrene spheres and even microbeads in some of the samples, the **majority of microplastics we found** were fragments formed from the **break-up of larger plastic items, perhaps household products or single-use packaging**. In most cases it will remain impossible to trace the fragment back to a specific product or source.

5. As was the case for the samples of microplastics collected by Greenpeace UK from surface seawater around the coast of Scotland in 2017 (Santillo *et al.* 2018), **all samples in our study contained different types, sizes, forms and amounts of plastic**. While this may be typical, even inevitable, for a contaminant of such discrete nature as microplastic, given the vast diversity of uses of plastic and routes to the environment, it highlights the challenge facing scientists who attempt to quantify risks posed by microplastics within the aquatic environment.

   By allowing the discharge and loss of plastics into our freshwater ecosystems, **we have created a problem of enormous complexity and unpredictability**, and one to which we are adding every hour of every day until we stop the flow of plastic at source.

6. In this study, we have not been able to investigate the possible implications of exposure to the plastic pollution we have measured for the UK's aquatic wildlife or human health. Nevertheless, given what is known already about the effects of both macro and microplastics on marine wildlife, and the observations from other studies that microplastics can be consumed by a range of freshwater species, it is reasonable to assume that **plastic pollution of our rivers poses some level of threat to freshwater ecosystems**.

   There is an urgent need for greater research to focus on exposures, food web transfer and mechanisms of biological effect arising from plastic pollution of our waterways, as well as for effective measures to identify, control and, as far as possible, eliminate sources upstream.

7. We know from other studies, again mainly in the marine environment, that **plastics can contain additives and chemicals that become attached to their surfaces**. Among these are: bisphenol A (BPA), a known endocrine-disrupting compound; polychlorinated biphenyls (PCBs), which are known to cause cancer and affect the reproductive systems of animals; and dichlorodiphenyltrichloroethane, the pesticide DDT, which is another known carcinogen. (Browne *et al.* 2013; Rochman *et al.* 2013; Gauquie *et al.* 2015; Rani *et al.* 2017).

   In our earlier work on microplastics collected from the sea surface around the coast of Scotland, we reported that the mixtures of chemicals associated with accumulations of microplastics showed the same levels of complexity and unpredictability as microplastics themselves (Santillo *et al.* 2018). There is no reason to expect this to be any different in freshwater ecosystems, particularly given the more direct exposure rivers face from discharges and run-off (i.e. pesticides, industrial chemicals, antibiotics).

# WHAT NEEDS TO BE DONE?

**The results of this study add to the overwhelming body of evidence that there is a plastic pollution crisis affecting our human, freshwater and marine environments.** If the Government is to show leadership in meeting this challenge, there must first be an understanding and acknowledgment that relying on recycling or switching to other materials is inadequate at best and harmful at worst. Plastic production is set to quadruple by 2050 (World Economic Forum, 2016), and as a material can only be functionally recycled a limited number of times. Therefore, we need a strategy to phase out all non-essential, single-use plastic packaging and a transition to a society in which refillable, reusable containers and materials are the norm.

The **upcoming Environment Bill**, the first such bill in the UK for more than 20 years, offers a clear opportunity to enact policy measures to radically reduce single-use plastic and put us on course to end all plastic pollution for good.

**The Government should set legally binding targets to reduce the production and use of single-use plastic packaging by at least 50% by 2025.**
These would lead to a shift towards packaging-free, reusable and refillable products that would drive down demand for and production of single-use plastics. These targets must be overseen by a well-funded, independent watchdog with the power to hold the UK Government and public bodies to account.

**The Government should commit that by 2042 at the latest, no waste, including plastic pollution, enters the environment.**
Vast quantities of microplastics, including some of those found in our testing, come from the wear and tear of vehicle tyres, synthetic clothes and paints. Tackling these pollution sources will require innovative, long-term and ambitious action. As part of a wider objective to end all waste through minimisation, the Government should commit to ending all plastic pollution entering the environment as soon as possible.

**The Government should introduce a deposit return scheme for drinks containers of all sizes and materials, that is designed to be adapted for reuse and refill functions in the future.**
13 billion plastic drinks containers are used in the UK every year (Environmental Audit Committee, 2017), representing 25% of all plastic brought into the UK market. A deposit return scheme would significantly increase capture of this waste, and in future should be a mechanism for drastically increasing the UK market for refillable and reusable drinks containers.

**The Government should radically overhaul extended producer responsibility (EPR) obligations on packaging producers – so that they reflect the full environmental costs of their operations.** This should include pre-production pellet loss, carbon emissions from the extraction and transportation of fossil fuels and of chemicals released in the production of plastic resins and additives, as well as the impact of macro and microplastic pollution.

**The Government should introduce taxes and charges to disincentivise the use of any virgin materials in packaging applications.**
All materials have environmental consequences and we need to revolutionise systems of packaging as a whole, rather than focusing on substituting one single-use material for another.

**Extend the ban on microbeads** to include all types of products covered in the proposed EU-wide restriction, including household cleaning products and leave-on cosmetics. The prevalence of microbeads in our findings shows that the limited ban implemented in January 2019, which focused primarily on rinse-off products, does not go far enough. The Government must follow the example of the European Chemicals Agency and immediately widen the scope of the ban.

Implement measures to ensure incineration is no longer a viable option for waste management. **This should include an incineration tax, a moratorium on new incineration capacity, and ensuring EPR payments encourage reduction, reuse and creation of new recycling infrastructure**.

## Take action:

**Constituents can call on their MP to pledge to support a strong Environment Bill, and MPs can directly pledge at www.plasticfreerivers.org.uk**


A coot is pictured with plastic in the River Lea, 13 May 2019.

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Cover image: A coot sits on a nest built with plastic in the River Lea, 13 May 2019. ©Perks/Greenpeace.
Back image: Banded demoiselle in the River Stour, Birmingham, 21 May 2019. ©Perks/Greenpeace.

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