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Plastic waste in the marine environment

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This research paper outlines the current state of knowledge regarding the scale of marine plastic pollution in Northern Ireland (NI) and its potential impacts. It also summarises current policy and legislation of relevance to marine plastic pollution in NI and describes further initiatives proposed or implemented elsewhere in the UK, in the Republic of Ireland, and further afield.

Key Points

- Globally, over 300 million tonnes of plastics are produced each year. A large proportion of this ultimately ends up discarded as waste.
- The high durability of plastics makes them useful materials for a variety of functions. However, it also means that plastics take hundreds to thousands of years to degrade.
- Between 2 and 5% of all plastic waste produced annually on land ultimately ends up in the sea. Without further action, the quantity of plastic in the sea is expected to treble between 2015 and 2025.
- In Northern Ireland (NI), data from beach litter surveys and seafloor bottom trawls identify plastics in the marine environment in both coastal and offshore areas.
- Marine plastic waste can have many detrimental effects, including harm to biodiversity, economic costs to the fishing industry and reduction of coastal visitation rates.
- Whilst marine plastics cause many problems, some common concerns currently have little evidence to support them e.g. human health impacts of consuming microplastic-contaminated seafood.
- Packaging accounts for the largest share of plastic waste in the UK (47% of all plastic waste).
- It is estimated that the majority of plastic waste which ends up in the oceans comes from a small number of Asian countries including China, Indonesia and the Philippines.
- Whilst NI would not appear near the top of this list, much of the UK's plastic waste is sent to countries with poor records on waste management.
- Offshore dumping of waste is regulated by a series of international agreements.
- Marine litter and waste management is currently guided by a series of European Union (EU) directives. Locally, these are interpreted in the form of the NI Marine Litter Strategy and Waste Management Strategy.
- Legislation is in place in NI to regulate two specific plastic products: microbeads in cosmetic products and plastic carrier bags.
- Further bans on single-use plastic products have recently been agreed by the EU and policies have also been proposed in England and Scotland.
- The UK Government has recently proposed three new UK-wide policies to tackle plastic waste: a plastic bottle Deposit Return Scheme, a plastic packaging tax, and reforms to the packaging producer responsibility system.
- In some aspects of plastics policy, strategy has diverged across UK devolved administrations e.g. a levy on disposable cups has been ruled out in England, is under consideration in Wales and has been pledged as part of a cross-party political deal in Scotland.

- Plastics policy in the Republic of Ireland (RoI) is less extensive than in the UK. There is no legislation on microbeads (although it is expected in Summer 2019) and proposals for a deposit return scheme, a plastic packaging tax, a disposable cup levy and a single-use plastics ban have all been either ruled out or delayed by government.
- Across the world, policies which could address marine plastics by tackling plastic production and use, generally focus on improving collection rates for recycling or banning/taxing specific plastic products or materials.
- Across the EU, policies addressing plastics already in oceans are commonly based on principles from international conventions (e.g. MARPOL) and EU Directives.
- Local councils, industry and voluntary groups have also developed a wide variety of initiatives within NI and across the whole of the UK. These operate from the level of international industrial collaboration, to local community-led activities.

Executive Summary

The following paper outlines the extent of marine plastic pollution, both globally and around Northern Ireland (NI), and discusses potential impacts such as detrimental effects on local marine wildlife, the fishing industry and the use of the NI coastline for tourism and recreation. It considers the roles of different countries and industrial sectors in plastic waste production and loss into oceans, as well as the relative importance of land- and sea-based sources of plastic pollution. The paper then summarises current and proposed policies for tackling marine plastics in NI, other UK legislatures and the Republic of Ireland, and outlines strategies adopted further afield. Finally, it highlights a range of local, national and international initiatives run by local councils, industry and voluntary organisations that are currently operating in NI.

Since large scale plastic manufacturing began in the 1950s, global production has expanded from 2 million to over 300 million tonnes each year. In total, it is estimated that approximately 8 billion tonnes of plastics have been produced since plastic production began, over half of which has ended its life discarded or in landfill. In 2015, 275 million tonnes of plastics were discarded as waste.

Of the plastic waste produced on land, it is estimated that between 4.8 and 12.7 million tonnes enter oceans each year. On top of this, the loss/discarding of fishing gear at sea also contributes to total levels and these can be particularly hazardous to wildlife. As plastics can take hundreds to thousands of years to degrade, the plastics in oceans are effectively permanent without further action. The abundance of plastics in the world's oceans, and particularly its impact on marine wildlife, is an issue of which public awareness has expanded rapidly in recent years.

Within NI, the presence of plastic waste is well documented on beaches (through regular litter surveys) and on the seafloor (by recording plastic items caught in bottom trawls). It is also reasonable to assume that NI has a greater impact on marine plastic pollution than assessed in these surveys alone. Plastics originating from NI can travel thousands of miles across the world, whether by transportation on ocean currents or by the global trade of plastic waste.

Policies which aim to tackle marine plastic pollution can target three main areas:

(i) Plastic use and production

Whilst some legislation is in place in NI to regulate specific plastic products (the ban on plastic microbeads in personal care products and the carrier bag charge), Scotland, England and the European Union (EU) have recently gone further to develop plans to put bans on specific single-use plastic products. Further proposals for a UK-wide deposit return scheme for beverage containers and a tax on plastic packaging are currently under consideration.

(ii) Preventing plastic waste entering the sea

To date, much of NI's framework for managing waste (e.g. recycling targets) and marine litter has been guided by EU directives. The UK currently operates a producer responsibility scheme which requires manufacturers to contribute financially to the retrieval and disposal of plastics and this system is currently under review. The new EU Single-Use Plastics Directive includes requirements for producer responsibility schemes which extend to single-use products and discarded fishing gear. The disposal of plastic waste at sea is banned by a series of international conventions.

(iii) Removing plastic already present in the sea

Strategies for the removal of marine plastic in NI are generally operated by councils, which are required to remove litter on 'amenity beaches' within the bathing season, or voluntary organisations which organise beach clean events throughout the year. Other initiatives include schemes which provide facilities for fishers to return plastic by-catch to port and harbour facilities, and investment in technologies designed to filter litter from seawater.

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1 Introduction to marine plastics

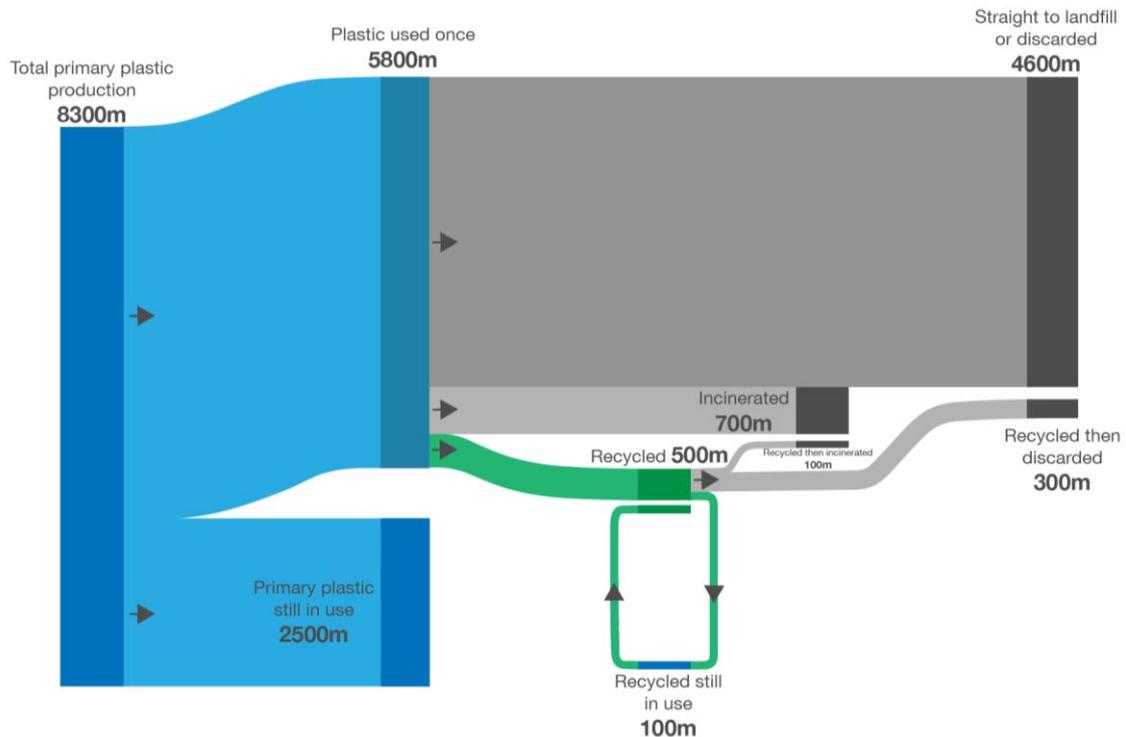


Figure 1. The fate of all plastics produced globally between 1950 and 2015. From: Ritchie and Roser, 2018¹, based on data from Geyer *et al.*, 2017², used under Creative Commons CC-BY-SA.

1.1 Why plastics?

Since large-scale plastic production began in the 1950s, over 8 billion tonnes of new (virgin) plastics have been manufactured globally³ (Figure 1). The production of plastics has grown rapidly over recent decades and now exceeds that of most other man-made materials, occurring at a rate of more than 300 million tonnes per year⁴. Plastic materials have many highly desirable properties including being durable, lightweight and low cost, making them suitable for packaging as well as many other commercial applications.

The durability of plastics also poses environmental challenges because waste plastics degrade very slowly in the environment. The lifespan of plastics in the environment is estimated to be in the order of hundreds to thousands of years⁵. Therefore, plastics

¹ Our World in Data (2018) [Plastic pollution](#).

² Geyer R, Jambeck JR, Law KL. Production, use, and fate of all plastics ever made. *Science advances*. 2017 Jul 1;3(7):e1700782. doi: [10.1126/sciadv.1700782](https://doi.org/10.1126/sciadv.1700782)

³ *ibid*

⁴ Plastics Europe (2018) [Plastics – the Facts 2018](#)

⁵ Barnes, D.K., Galgani, F., Thompson, R.C. and Barlaz, M., 2009. Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1526), pp.1985-1998. doi: [10.1098/rstb.2008.0205](https://doi.org/10.1098/rstb.2008.0205)

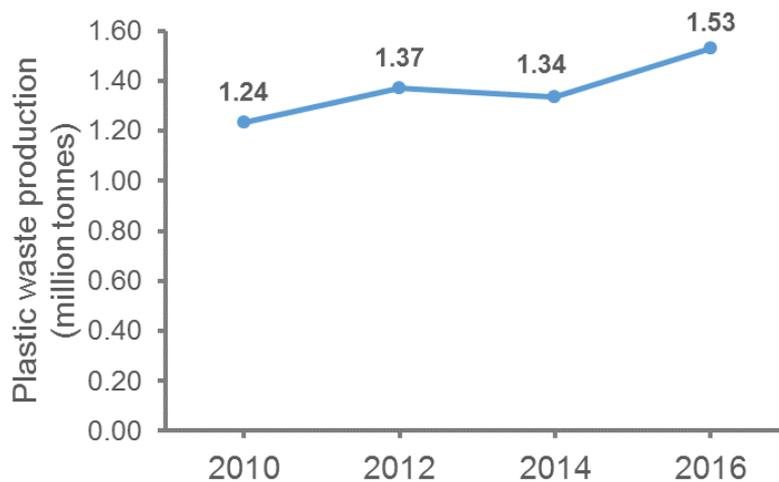


Figure 2. UK plastic waste production 2010-2016 as reported by Defra, 2019⁶ (used under an Open Government Licence).

represent a particularly persistent form of waste and once produced can be effectively permanent in the environment unless retrieved and re-used, recycled or incinerated.

1.2 UK plastic waste production

Large quantities of plastics are discarded as waste every year. Across the UK, the most recent data from the Department for Environment, Food and Rural Affairs (Defra) estimates plastic waste production in 2016 of 1.53 million tonnes, up from 1.24 million in 2010 (Figure 2) ⁷. However, a report for the World Wildlife Fund for Nature (WWF) suggests that UK plastic waste production could be much higher than this, reporting a figure of 4.9 million tonnes for the year of 2014⁸.

1.3 Why the marine environment?

The world's oceans and seas are a major sink of plastic waste. A study in 2015 calculated that between 4.8 and 12.7 million tonnes of plastic waste (2 to 5% of plastic waste generated annually) enters oceans every year from coastal countries⁹. In Europe, 80-85% of man-made debris found in oceans is made of plastic¹⁰. Plastics have been recorded across the world, from coastal areas to the mid-ocean and from the sea surface to the seabed, as well as in marine sediments, in organisms and in the

⁶ Defra, 2019 [UK Statistics on Waste](#), 6 March 2019

⁷ *ibid*

⁸ WWF, 2018 [A Plastic Future: plastics consumption and waste management in the UK](#)

⁹ Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. *Science*. 2015 Feb 13;347(6223):768-71. doi: [10.1126/science.1260352](https://doi.org/10.1126/science.1260352)

¹⁰ European Parliamentary Research Service, 2018 [Single-use plastics and fishing gear](#), Briefing, EU Legislation in Progress

Box 1. Definitions of common terms used around plastic waste at sea.

Definitions	
Microplastic	Small plastic particles, typically less than 5mm. May be formed through the degradation of larger plastic pieces, including solid plastics and synthetic fibres (secondary microplastics), or specifically manufactured (primary microplastics) and either added to products (generally for their abrasive properties) or used as pellets in the plastic production process (nurdles).
Nanoplastic	Very small plastic particles, typically less than a thousandth of a millimetre.
Macroplastic	Any plastic particle of size greater than 5mm.
Microbead	Small plastic spheres or pellets commonly added to cosmetic or household products. Now banned in rinse-off personal care products in Northern Ireland ¹¹ . A type of primary microplastic.
Nurdles	Pre-production plastic pellets (often approximately lentil-sized) used in plastic manufacturing (also sometimes known as 'mermaid's tears').
Virgin plastics	New plastic materials, manufactured directly from petrochemicals rather than recycling pre-existing plastics.

ocean's deepest trenches^{12,13}. Plastic pollution can harm biodiversity and human wellbeing, and can incur economic costs to industry and government.

1.4 The scale and distribution of marine plastic waste globally

As of 2015, 6.3 billion tonnes of plastic waste had been produced worldwide, of which 79% had accumulated in landfills or the natural environment, including marine waters and coastal areas¹⁴.

A [report from the Government Office for Science in 2018](#) estimated that without further action, the quantity of plastic in the oceans is expected to treble in the ten years from 2015 to 2025¹⁵. An [Ellen MacArthur Foundation report](#) from 2017, estimated that by

¹¹ [The Environmental Protection \(Microbeads\) Regulations \(Northern Ireland\) 2019](#).

¹² Chiba S, Saito H, Fletcher R, Yogi T, Kayo M, Miyagi S, Ogido M, Fujikura K. Human footprint in the abyss: 30 year records of deep-sea plastic debris. *Marine Policy*. 2018 Oct 1;96:204-12. doi: [10.1016/j.marpol.2018.03.022](https://doi.org/10.1016/j.marpol.2018.03.022)

¹³ Thompson, R. S., 2017 [Future of the Sea: Plastic Pollution](#). Government Office for Science.

¹⁴ Our World in Data, 2018, [Plastic pollution](#).

¹⁵ Government Office for Science, 2018, [Foresight: Future of the Sea](#), A Report from the Government Chief Scientific Adviser

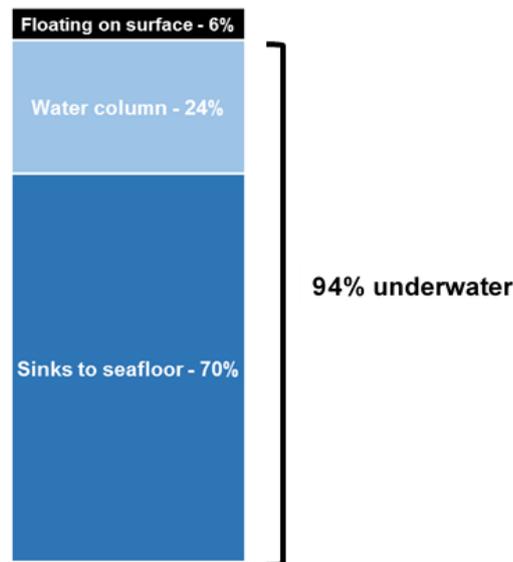


Figure 3. Proportion of marine plastics settling to different parts of the water column. Data from Green Alliance, 2017¹⁶.

2025 there will be one tonne of plastic for every three tonnes of fish, with oceans containing more plastic than fish by mass by 2050¹⁷.

Once in the sea, plastics are free to move on ocean currents and are known to accumulate along shorelines, on the seabed and floating in mid-ocean gyres (locations of circulating currents). Within the water column, plastics settle to different levels dependent on buoyancy. Figures from environmental think tank Green Alliance estimate that 94% of plastics in the sea are to be found underwater, with the majority (70%) ultimately sinking to the seafloor¹⁸ (Figure 3).

2 The scale of marine plastics in Northern Ireland

The coast of Northern Ireland (NI) is a major asset, valuable in terms of culture, tourism, recreation and its support of coastal communities and the fishing industry. The presence of marine plastic waste has the potential to harm the natural environment and thus damage the ability of the NI coast to provide these services.

The [Oslo and Paris Convention for the Protection of the Marine Environment of the North-East Atlantic \(OSPAR Convention\)](#), signed by 16 contracting parties including the United Kingdom (UK), Republic of Ireland (RoI) and the European Union (EU),

¹⁶ Green Alliance, 2017 [Marine Plastics – What happens to plastic in the sea?](#)

¹⁷ Estimate assumes rates of plastic deposition into oceans increase in line with the plastic packaging industry projections from 2015-2025 increasing by 4.8% annually, and then reduce to 3% from 2026 onwards. It also assumes stable fish stocks from 2025-2050. Ellen MacArthur Foundation, 2017 [The new plastics economy: rethinking the future of plastics & catalysing action](#), p. 12

¹⁸ Green Alliance, 2017 [Marine Plastics – What happens to plastic in the sea?](#)

supports periodic assessments of the status of the marine environment in the North-East Atlantic region. NI falls within the Celtic Seas reporting sub-region, along with the RoI, the Isle of Man and the west coast of Britain. Data submitted to the OSPAR Commission is a major source of information on marine debris in NI adjacent waters.

2.1 Beach litter

Since 2012, environmental charity Keep Northern Ireland Beautiful (KNIB; previously Tidy NI), have collected data on beach litter quarterly from ten beaches along the NI coast, supported by the Department for Agriculture, Environment and Rural Affairs (DAERA) (previously the Department for Environment, DoE). Data from these surveys are reported in the annual KNIB [Marine Litter report](#). The most recent report (data from 2017) reports an average of 358 plastic items found for every 100m of beach surveyed¹⁹ (Figure 4). The most commonly recorded litter items in 2017 were plastic and polystyrene pieces (of unidentified origin), plastic string, cord and rope, plastic drinks containers, and plastic drinks caps and lids.

When compared to the other sites in the Celtic Seas, NI beaches report a very similar number of plastic items, whilst showing fewer litter items of other materials. It must be noted, however, that the KNIB Report highlights that conclusions drawn from direct comparisons can be uncertain because whilst NI is relatively well sampled, fewer surveys are available elsewhere in the Celtic Sea region. Also, individual litter counts can vary between years, at different times of year and with differences in weather. Surveys follow a standardised methodology implemented across the OSPAR nations and are submitted to OSPAR in contribution to monitoring across the North-East Atlantic regional sea.

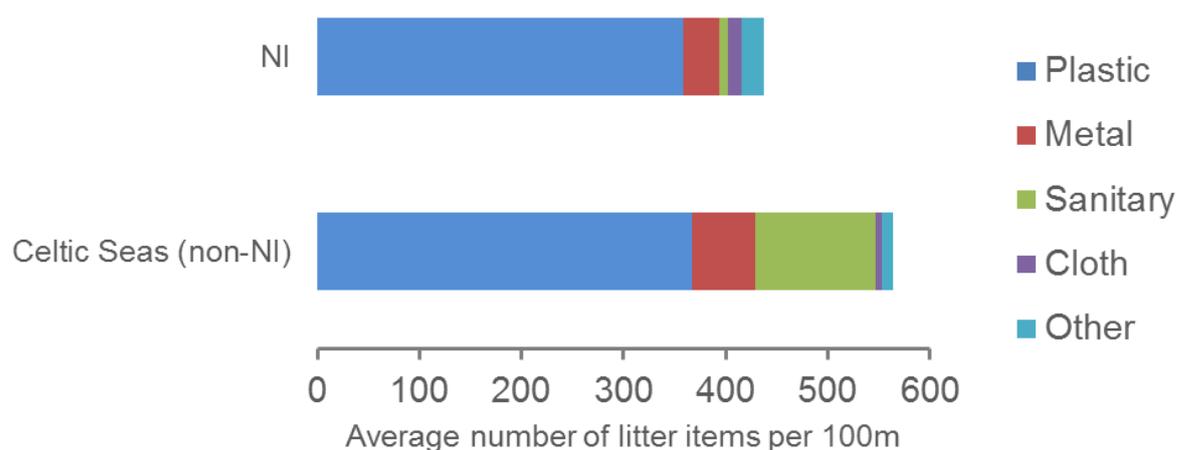


Figure 4. Average litter counts by material for Northern Ireland and elsewhere in the Celtic Seas in 2017. Data from KNIB, 2018²⁰.

¹⁹ Keep Northern Ireland Beautiful, 2018 [Marine Litter Report 2017](#) p.10

²⁰ *ibid*

Whilst the KNIB surveys supply perhaps the most standardised and comprehensive assessment of beach litter in NI, other initiatives collecting data include the Marine Conservation Society annual [Beachwatch](#) beach clean events, the European Environment Agency's [Marine LitterWatch](#), and the NI Environment Agency (NIEA) routine monitoring of bathing beaches.

2.2 Offshore litter

Records of litter caught as by-catch in bottom trawling fisheries can be used to assess the abundance of plastic waste in offshore seafloor environments.

Data for waters off the northern coast of NI are available from [OSPAR seafloor litter data](#) collected from standardised bottom trawl surveys. These show an increase in plastic litter frequency from north to south in the waters around the UK and Ireland (Figure 5). Despite concerns about plastic abundance on the seafloor across the

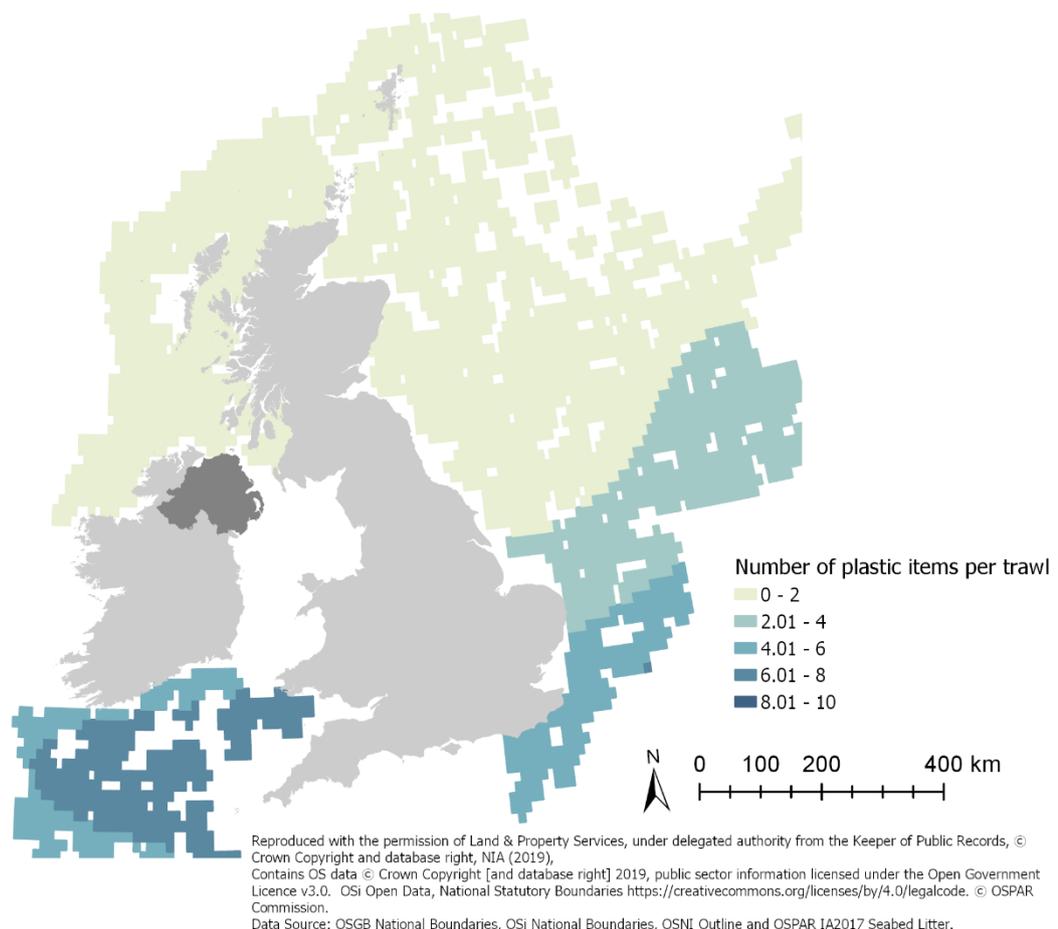
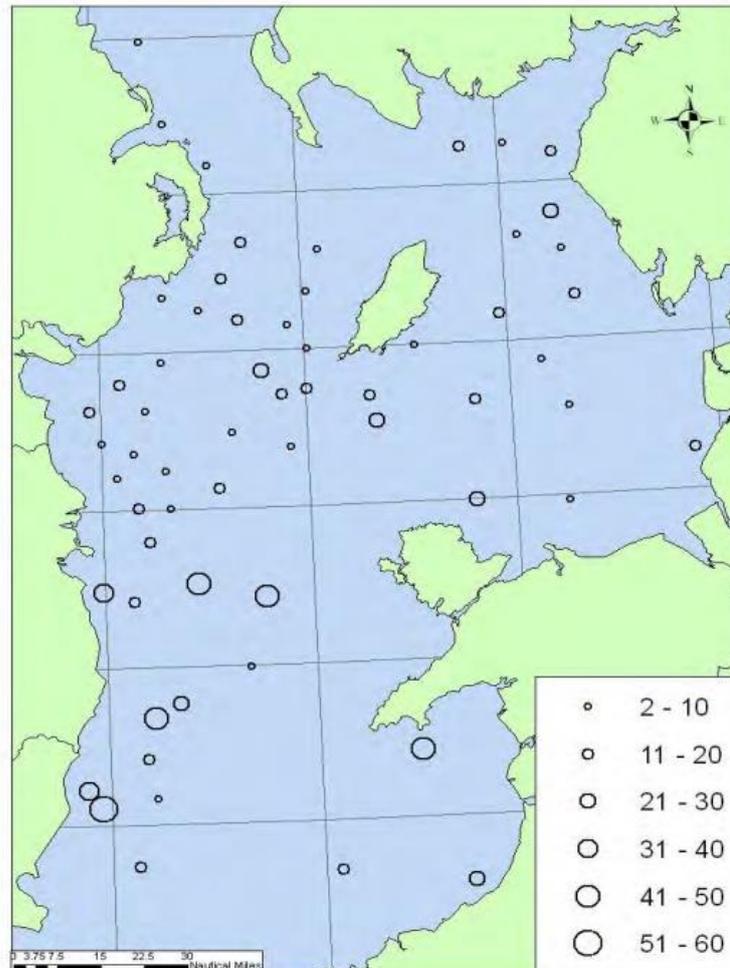


Figure 5. OSPAR seafloor litter surveys – figures indicate average number of plastic litter items caught in bottom trawls (data smoothed spatially). Data from OSPAR, 2017²¹.

²¹ OSPAR Commission, 2017 [Composition and Spatial Distribution of Litter on the Seafloor](#)



Source: DAERA Marine and Fisheries Division

Figure 6. Offshore litter items caught per trawl station in the period 2017/2018. Figure from DAERA, 2019²².

general North-East Atlantic region, trawl sites near to the coast of NI (all off the north coast) show less than two plastic items per trawl. The [OSPAR Intermediate Report 2017](#) states that variation in seafloor litter abundance could be due to differences in “anthropogenic inputs²³, rivers, prevailing winds and/or currents”.

Off the east coast, [monitoring programmes have been developed by DAERA](#) surveying litter caught in bottom trawls from 65+ stations within the Irish Sea (*Figure 6*). These data are used to address Marine Strategy Framework Directive Descriptor 10. In the 2018 Environmental Statistics Report, DAERA commented:

“Numbers of items per offshore trawl have been very consistent from survey to survey over recent years, however, more data on litter and tidal

²² DAERA, 2019 [Northern Ireland Environmental Statistics Report, May 2019, p. 65](#)

²³ Human-related sources

currents is needed before informed assessment of hotspots and sources can be made.”²⁴

In the 2019 report, DAERA added:

“An assessment of all of the data since 2010 is due next year and will comment on trend, sources and litter types.”²⁵

These data describe only those plastic items large enough to be trapped within fishing nets, therefore do not survey microplastics (plastic fragments less than 5mm, see Box 1) and other small plastic fragments.

2.3 Data gaps

Whilst these data begin to provide a useful picture of marine plastics in NI, there remain uncertainties about the scale of marine plastic waste in NI and the fate of plastics arising from NI, including:

- Microplastics

Microplastics are too small to be identified in beach and seafloor litter surveys. Densities of microplastics (plastic fragments <5mm, see Box 1) are likely to vary across locations due to accumulation along coastlines and in mid-ocean circulating currents (gyres)²⁶. Locally, microplastics have been identified in sediments along the western Irish continental shelf²⁷ and around the southwest of England²⁸, in sub-surface waters in the North-East Atlantic Ocean²⁹.

Defra has recently stated their intention to work with the OSPAR to develop an indicator for microplastics in sediments³⁰.

- Global movements

Marine plastics are mobile and can travel in ocean currents. Plastics in NI waters may not all have a NI origin and likewise, once released into the sea, plastics from NI may travel into foreign waters.

²⁴ DAERA, 2018 [Northern Ireland Environmental Statistics Report, May 2018, p. 66](#)

²⁵ DAERA, 2019 [Northern Ireland Environmental Statistics Report, May 2019, p. 65](#)

²⁶ Cole M, Lindeque P, Halsband C, Galloway TS. Microplastics as contaminants in the marine environment: a review. Marine pollution bulletin. 2011 Dec 1;62(12):2588-97. doi: [10.1016/j.marpolbul.2011.09.025](#)

²⁷ Martin J, Lusher A, Thompson RC, Morley A. The deposition and accumulation of microplastics in marine sediments and bottom water from the Irish continental shelf. Scientific reports. 2017 Sep 7;7(1):10772. doi: [10.1038/s41598-017-11079-2](#)

²⁸ Thompson RC, Olsen Y, Mitchell RP, Davis A, Rowland SJ, John AW, McGonigle D, Russell AE. Lost at sea: where is all the plastic?. Science. 2004 May 7;304(5672):838. doi: [10.1126/science.1094559](#)

²⁹ Lusher AL, Burke A, O'Connor I, Officer R. Microplastic pollution in the Northeast Atlantic Ocean: validated and opportunistic sampling. Marine pollution bulletin. 2014 Nov 15;88(1-2):325-33. doi:[10.1016/j.marpolbul.2014.08.023](#)

³⁰ Defra, Welsh Government, DAERA, Scottish Government, [UK updated assessment and Good Environmental Status: Consultation document](#), May 2019

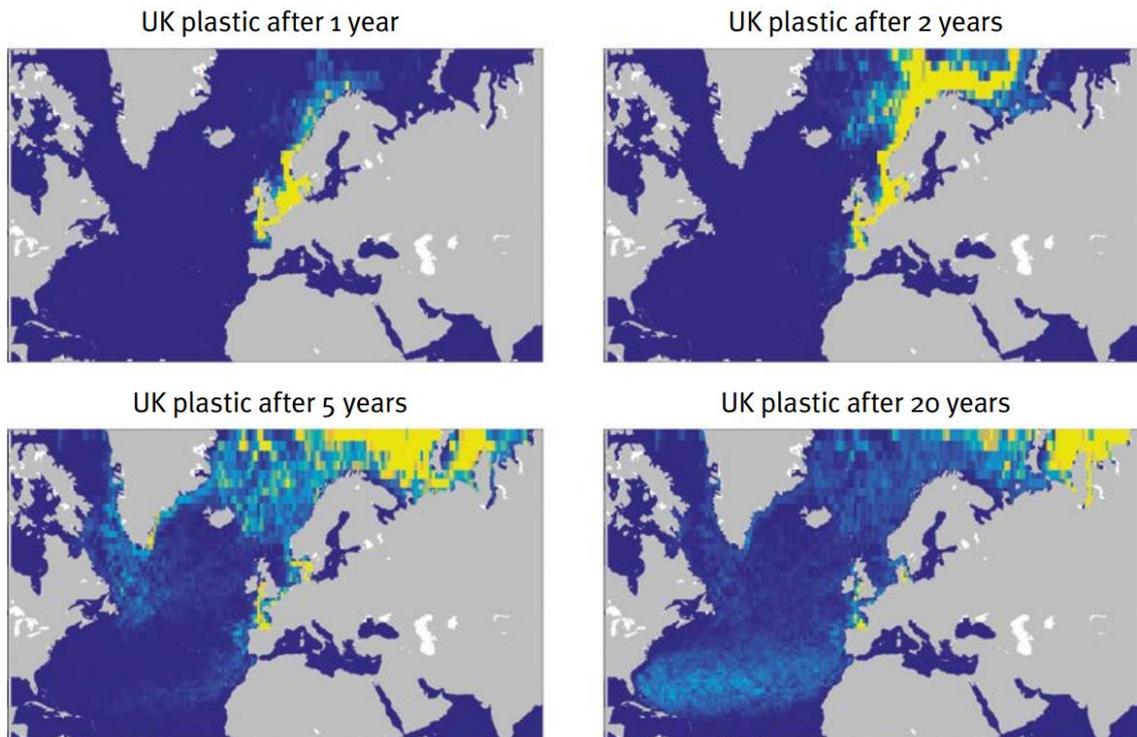


Figure 7. Prediction of the location of floating plastics released from the UK up to 20 years after release based on ocean circulation models (plastic release from the UK coastline assumed to be in proportion to local population density)³¹.

Floating plastics can be transported offshore and accumulate in mid-ocean gyres (locations of circulating currents where floating debris gathers). It is currently unclear what proportion of plastic waste arising from NI is transported offshore to contribute to overseas plastic pollution. However, models suggest that most floating plastic released from the UK that is not washed up on beaches ultimately reaches the Arctic within 20 years (Figure 7)³².

The movement of floating plastics may be more important than expected given the relatively small proportion of total plastics found floating on the ocean surface (6%; Figure 3). Much of the plastic found underwater was once buoyant, sunk over time due to processes such as degradation and biofouling. As plastics are most mobile when buoyant, this initial phase could be particularly important in determining ultimate distributions.

³¹ van Sebille E, Spathi C, Gilbert A, 2016, [The ocean plastic pollution challenge: towards solutions in the UK](#), Grantham Institute, Imperial College London, 19.

³² *ibid*

Whilst models of global ocean circulation can be used to predict the movement of marine plastics, current models do not account for future changes in ocean currents and weather patterns expected in response to climate change³³.

- Ingested plastics

Plastics ingested by marine wildlife or commercial species are not routinely surveyed in NI at present. Surveys of plastic contents of stomachs of seabird carcasses are carried out elsewhere in the UK (e.g. [Fulmar stomachs in the North sea](#)).

3 Impacts of marine plastics

3.1 Biodiversity

Marine plastics are commonly cited as a major threat to marine biodiversity. Encounters between plastic debris and marine organisms have been reported in over 700 species³⁴. A 2016 report by the EU Marine Strategy Framework Directive expert group concluded:

*“The evidence provided within this report shows the large-scale and serious threat that marine litter poses to the welfare of marine animals”.*³⁵

Impacts such as entanglement in large plastic debris and ingestion of macroplastics in marine birds and mammals are particularly well documented and can often be lethal³⁶.

Entanglement is generally easy to observe and is therefore commonly reported. Entanglement in plastic debris has been well documented in approximately 250 species including mammals, birds, fish and turtles³⁷. Studies around the UK coast suggest that rates of entanglement could be 2-9% for some marine birds and mammal species³⁸. Although most marine plastic is believed to have a land-based source, rope and netting (likely discarded by the fishing industry) has a disproportionate impact on entanglement, accounting for 71% of incidents³⁹.

In comparison to entanglement which is usually visually evident, it can be challenging to identify a clear link between plastic ingestion and harm to organisms in individual cases. Ingestion is generally only discovered if a dead organism is dissected. Plastic ingestion has been reported in approximately 300 marine species including

³³ Welden NA, Lusher AL. Impacts of changing ocean circulation on the distribution of marine microplastic litter. Integrated environmental assessment and management. 2017 May 1;13(3):483-7. doi: [10.1002/ieam.1911](https://doi.org/10.1002/ieam.1911)

³⁴ Thompson, R. C., 2017 [Future of the Sea: Plastic Pollution](#). Government Office for Science. p. 15

³⁵ European Commission, 2016 [Harm caused by Marine Litter](#). JRC Technical Reports.

³⁶ Convention on Biological Diversity, 2012 [Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions](#). Montreal, Technical Series No. 67.

³⁷ Thompson, R. C., 2017 [Future of the Sea: Plastic Pollution](#). Government Office for Science.

³⁸ European Commission, 2016 [Harm caused by Marine Litter](#). JRC Technical Reports.

³⁹ Gall SC, Thompson RC. The impact of debris on marine life. Marine pollution bulletin. 2015 Mar 15;92(1-2):170-9. doi: [10.1016/j.marpolbul.2014.12.041](https://doi.org/10.1016/j.marpolbul.2014.12.041)

invertebrates, fish, birds and mammals⁴⁰ and plastics can either be directly ingested from the environment, or indirectly through the consumption of plastic-containing prey.

The impacts of microplastics on marine wildlife are uncertain^{41,42}. There is considerable evidence of ingestion by marine wildlife (fish, birds, mammals, invertebrates). Yet, few studies examine the rate at which plastics are excreted, which is important for understanding long-term accumulation. There is some evidence to show translocation of microplastic particles from the gut into other body tissues in mussels and fish. However, there is only limited evidence that microplastic ingestion is harmful to organisms or that microplastics transfer harmful levels of associated chemicals to organisms. Where evidence for harmful effects come from laboratory experiments, these are often carried out under unrealistic levels of microplastic exposure.

Further potential impacts on biodiversity include the spread of invasive species carried on floating plastics and physical changes to the seabed environment due to plastic accumulation.

At present there is no clear evidence of population level impacts of marine plastics. However ecological systems are highly complex and it is extremely challenging to definitively link a single causative agent to changes in natural populations⁴³. A lack of evidence for population level effects does not necessarily mean that none exist.

3.2 Fisheries and aquaculture

Marine plastics have the potential to threaten the fishing and aquaculture industries if they pose a threat to the health and sustainability of commercially important stocks, or the economic viability of practices. Various commercially important species are known to ingest microplastics⁴⁴. However, as with other marine organisms, the impact of microplastic ingestion on fish health and stock sustainability is uncertain.

Outlined below are some select examples of ways in which fishing and aquaculture industries could be impacted by marine plastics, specific to NI.

Example 1 – Sea fishing: *Nephrops* fisheries

In NI, the sea fishing industry is heavily reliant on stocks of *Nephrops norvegicus* (known variously as prawn, scampi, Norway lobster, Dublin Bay prawn, langoustine; herein simply *Nephrops*), which constituted 33% of the total catch (6,200 tonnes) and

⁴⁰ Thompson, R. C., 2017 [Future of the Sea: Plastic Pollution](#). Government Office for Science.

⁴¹ Burns, E. E., Boxall, A. B. A., 2018, Microplastics in the Aquatic Environment: Evidence for or Against Adverse Impacts and Major Knowledge Gaps. *Environmental Toxicology and Chemistry*. 37;11(2776-2796). doi: [10.1002/etc.4268](#)

⁴² GESAMP, 2016, [Sources, fate and effects of microplastics in the marine environment: part two of a global assessment](#).

⁴³ Gall SC, Thompson RC. The impact of debris on marine life. *Marine pollution bulletin*. 2015 Mar 15;92(1-2):170-9. doi: [10.1016/j.marpolbul.2014.12.041](#)

⁴⁴ European Commission, 2016 [Harm caused by Marine Litter](#). JRC Technical Reports.

50% of the commercial value (£14.7m) of landings in 2017 ⁴⁵ (see a [previous Research Matters blog](#) for further details of *Nephrops* fishing in NI).

Research conducted off the west and north coasts of Scotland has shown microplastic fibres trapped within the guts of *Nephrops*⁴⁶. *Nephrops* from the Clyde Sea area (less than 100km from the coast of NI) exhibited particularly high frequencies of microplastic ingestion, with 83% of individuals caught seen to contain microplastics. In the North Minch and North Sea, 43% and 29% of *Nephrops* caught contained microplastics.

The majority of microplastics found in *Nephrops* were plastic fibres, most commonly nylon and polypropylene which had become trapped within the digestive system. Larger individuals (often males) were seen to contain fewer plastic fibres than smaller individuals.

Further experimental research has shown that when *Nephrops* accumulate microplastic fibres to the levels observed in the Clyde Sea, this reduces body condition compared to individuals not exposed to plastics. The effects of microfiber ingestion are in line with effects observed in starved individuals⁴⁷. Reduced body condition after microfiber-exposure has the potential to affect the commercial value of *Nephrops* and the future sustainability of stocks.

Example 2 – Aquaculture: sea mussels

Shellfish farming is the largest aquaculture industry in NI, accounting for 46 out of 78 licensed fish farms and, as of 2016, with a value of £4.3 million. The main species cultivated in shellfish fish farms in NI are Blue mussels (*Mytilus edulis*) and Pacific oysters (*Magallana gigas*).

A 2019 study conducted in outdoor experimental chambers at the Portaferry Marine Laboratory, Co. Down concluded that repeated exposure to polyethylene (a common plastic used in packaging) could reduce the ability of blue mussels to attach to rocks and other surfaces on which they grow⁴⁸. The authors of the study suggest that this could be explained by substantial chemical changes to mussel haemolymph (blood) after microplastic exposure. If the ability to attach to surfaces firmly is impaired, mussels can be put at risk of washing away.

⁴⁵ Marine Management Organisation, 2018 [UK Sea Fisheries Statistics 2017](#). p. 44

⁴⁶ Welden NA, Cowie PR. Environment and gut morphology influence microplastic retention in langoustine, *Nephrops norvegicus*. *Environmental pollution*. 2016 Jul 1;214:859-65. doi: [10.1016/j.envpol.2016.03.067](#)

⁴⁷ Welden NA, Cowie PR., Long-term microplastic retention causes reduced body condition in the langoustine, *Nephrops norvegicus*. *Environmental pollution*. 2016, 1;218:895-900. doi: [10.1016/j.envpol.2016.08.020](#)

⁴⁸ Green DS, Colgan TJ, Thompson RC, Carolan JC., 2019, Exposure to microplastics reduces attachment strength and alters the haemolymph proteome of blue mussels (*Mytilus edulis*). *Environmental Pollution*. 1;246:423-34. doi: [10.1016/j.envpol.2018.12.017](#)

Example 3 – Economic costs of debris as by-catch

With an abundance of plastic waste in the marine environment, fishers frequently catch plastics in fishing gears and this can have economic implications due to time lost clearing and repairing nets. [A study focussing on the economic costs of marine debris \(of all materials\) to Scottish fisheries](#) estimated losses of between €17,219 and €19,165 (equivalent to around £14,900 to £16,600 at time of publishing) per fishing vessel per year (Figure 8)⁴⁹. This cost was mainly attributable to time spent clearing nets of debris, but other important factors included the need for net repairs and having to dump catch due to contamination of catches. Plastic waste makes up a majority of marine debris, therefore it could impose a substantial economic burden.

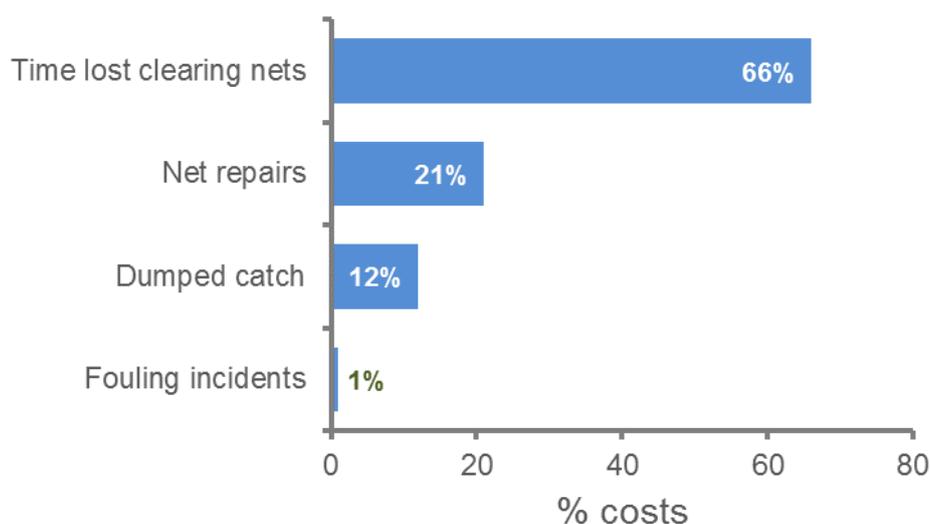


Figure 8. Breakdown of costs to Scottish fishing vessels of marine litter (total cost between €17,219 and €19,165). Data from Mouat *et al.*, 2010⁵⁰.

3.3 Human health

The main route through which marine plastic pollution has the potential to impact human health is through the consumption of microplastics in seafood. Once ingested, it has been suggested that microplastics could be harmful due to (i) microplastic accumulation in tissues or organs, (ii) leaching of toxic chemicals, or (iii) transmission of harmful pathogens living on plastic surfaces.

Reports from the UK Government's Chief Medical Officer⁵¹ and the United Nations Environment Programme (UNEP)⁵², both conclude that there is currently no evidence of negative human health impacts. However, both highlight significant knowledge gaps in this area.

⁴⁹ Mouat, J., Lopez Lozano, R., Bateson, H., [Economic Impacts of Marine Litter](#), September 2010. p. 57

⁵⁰ *ibid*

⁵¹ Annual Report of the Chief Medical Officer, 2017, [Health Impacts of All Pollution – what do we know?](#)

⁵² United Nations Environment Programme, 2016, [Marine Plastics Debris & Microplastics](#). Global lessons and research to inspire action and guide policy change.

Exposure to microplastics through seafood is likely to be very low when compared to exposure through plastic products in other aspects of day-to-day life⁵¹. For example:

- For most finfish and crustaceans, the gut (where microplastics accumulate) is removed before consumption.
- For bivalves, which are generally eaten whole, there is a greater potential for microplastic consumption. A 2014 study estimated that approximately 90 microplastic particles may be consumed in an average portion of mussels, and 50 particles for a portion of six oysters⁵³. There is currently no evidence to show what constitutes a harmful dose in humans. The process of depuration (where organisms are placed in clean water/artificial seawater for a number of hours to remove toxins before consumption) may help to remove some plastics prior to consumption⁵³.

3.4 Coastal visitation rates – impacts on tourism and wellbeing

Plastic marine waste, particularly beach litter, has the potential to reduce visitation to coastal sites. Coastal litter is commonly cited as a major reason why the public spends less time visiting, or avoids entirely, certain coastal sites⁵⁴.

Tourism

Coastal tourism sites rely on their reputation as clean and safe destinations. In the most recent available data from 2017, the NI Statistics and Research Agency (NISRA) estimate that tourists spent £926 million in NI⁵⁵. The contribution of coastal tourism to this value is unclear. However, three of the five most visited attractions in NI (Giant's Causeway, Titanic Belfast and the Carrick-a-Rede Rope Bridge) are in coastal locations⁵⁶. Across the UK it is clear that tourism tends to make a disproportionately large contribution to the economy of coastal communities⁵⁷. Marine litter has the potential to threaten key sources of tourism revenue.

Wellbeing

It is well documented that outdoor recreation has positive impacts on wellbeing through improvements to mental health and physical activity⁵⁸. The benefits of 'blue spaces' (spaces close to the coast and inland water bodies) may be due to cultural associations between the sea and health and wellbeing, and physical activities and social experiences often carried out near to the sea. However, when coastlines are littered,

⁵³ Van Cauwenberghe L, Janssen CR. Microplastics in bivalves cultured for human consumption. *Environmental pollution*. 2014 Oct 1;193:65-70. doi: [10.1016/j.envpol.2014.06.010](https://doi.org/10.1016/j.envpol.2014.06.010)

⁵⁴ KIMO, 2010, [Economic Impacts of Marine Litter](#)

⁵⁵ NISRA, 2018, [Northern Ireland Annual Tourism Statistics 2017](#). Tourism Statistics Bulletin.

⁵⁶ *ibid*

⁵⁷ Deloitte, 2008, [The economic case for the Visitor Economy. Final Report](#). Prepared for VisitBritain.

⁵⁸ Bell SL, Phoenix C, Lovell R, Wheeler BW. Seeking everyday wellbeing: The coast as a therapeutic landscape. *Social Science & Medicine*. 2015 Oct 1;142:56-67. doi: [10.1016/j.socscimed.2015.08.011](https://doi.org/10.1016/j.socscimed.2015.08.011)

encounters can have a negative impact on mood and litter can reduce the perceived 'restorative quality' of coastal visits⁵⁹.

3.5 Clean-up costs

In their Marine Litter Report 2017, KNIB estimates that marine litter (of which 82% was plastic in 2017) is responsible for a £36 million loss to NI amenity and £6 million loss to NI tourism⁶⁰.

4 The origins of marine plastics and routes into the marine environment

4.1 Origins of plastic waste by industrial sector

Global data from 2015 show that packaging is the biggest generator of plastic waste, accounting for 47% of all plastic waste (Figure 9). Plastic packaging is produced in large quantities (accounting for 42% of primary plastic production) and usually has a short lifetime. The synthetic textile industry is also a major contributor, and concerns have been raised about the release into water systems of synthetic microfibers shed during washing⁶¹. It should be noted that the relative contribution of different sectors is likely to vary between countries.

Within the UK, data from Defra for 2016 also separate plastic waste by industrial sector (albeit using a different categorisation system)⁶². These data show that the services industry is the biggest contributor of plastic waste in the UK, accounting for 53.8%. However, these data do not account for plastics found in mixed waste streams (e.g. plastics collected in general waste)⁶³. The WWF estimates that, when considering total plastic waste production is considered, packaging constituted up to 3.3 million tonnes (67%) of plastic waste in 2014⁶⁴.

Whilst these data illustrate the relative contributions of sectors to plastic waste production, these may not reflect the actual proportions of plastics from different sectors entering the sea. Once in the marine environment, the origins of individual plastic items can be difficult to determine.

⁵⁹ Wyles KJ, Pahl S, Thomas K, Thompson RC. Factors that can undermine the psychological benefits of coastal environments: exploring the effect of tidal state, presence, and type of litter. *Environment and behavior*. 2016 Nov;48(9):1095-126. doi: [10.1177/0013916515592177](https://doi.org/10.1177/0013916515592177)

⁶⁰ Keep Northern Ireland Beautiful, 2018 [Marine Litter Report 2017](#) p.5

⁶¹ House of Commons Library, 2019, [Plastic waste](#), Briefing Paper Number 08515

⁶² Defra, 2019 [UK Statistics on Waste](#), 7 March 2019, Table 5.2

⁶³ House of Commons Library, 2019, [Plastic waste](#), Briefing Paper Number 08515

⁶⁴ WWF, 2018 [A Plastic Future: plastics consumption and waste management in the UK](#)

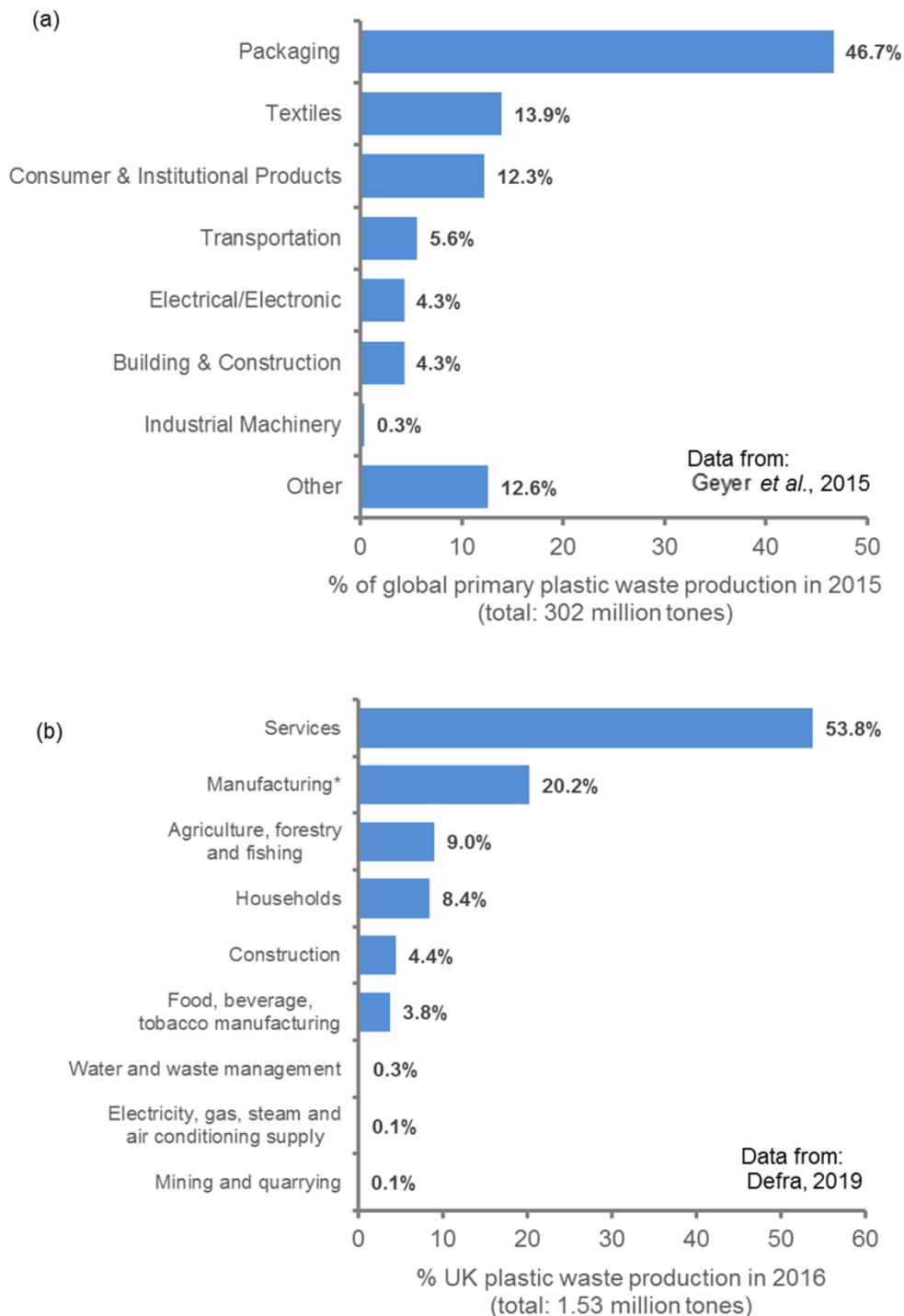


Figure 9. Global (a) and UK (b) plastic waste production by industrial sector. Data for the UK applied only to plastics collected in plastics only waste streams (no mixed waste). * Denotes manufacturing excluding food, beverage and tobacco manufacturing. Data from Geyer *et al.*, 2015⁶⁵ and Defra, 2019⁶⁶.

⁶⁵ Geyer R, Jambeck JR, Law KL. Production, use, and fate of all plastics ever made. *Science advances*. 2017 Jul 1;3(7):e1700782. doi: [10.1126/sciadv.1700782](https://doi.org/10.1126/sciadv.1700782)

⁶⁶ Defra, 2019 [UK Statistics on Waste](#), 7 March 2019, Table 5.2

4.2 Origins of marine plastics by country

A [2015 study](#) concluded that 20 countries account for 80% of global marine plastics⁶⁷. If all EU coastal countries were considered as a single unit, it would rank as the eighteenth greatest contributor.

Export of UK plastic waste to countries with poor records of waste management

Whilst the UK's contribution is small compared to the 20 countries which contribute most to marine plastics, in 2018 63% of plastic packaging collected for recycling in the UK was exported abroad⁶⁸ and much of it was sent to countries with poor records on waste management (it is unclear the extent to which imported plastic waste contributes to plastic pollution from these nations). China is considered to be the world's leading plastic polluter contributing more than a quarter of marine plastic waste⁶⁹. Until 2017 it was the major export market of UK plastic recycling waste⁷⁰.

More recently, many countries, such as China, Malaysia, Vietnam, Thailand and India, have implemented bans on waste imports or announced plans to phase out imports in coming years^{71,72,73}. Speaking in February 2019, a Defra spokesperson said:

“The Environment Secretary has been clear that we must handle more of our plastic waste at home. This is why we have set out reforms in our new Resources and Waste Strategy which will boost the domestic recycling market and impose tougher controls on the waste we do have to export.”⁷⁴

Whilst the Resources and Waste Strategy largely applies specifically to England, proposals such as a new plastic packaging tax, aimed at improving the market for recycled plastics, would apply across the UK (see section 6 of this paper – *Recent policy developments* for further details of the proposal).

In response to growing awareness of the global trade of plastic waste, the fourteenth meeting of the Conference of the Parties to the Basel Convention (BC COP-14) in May 2019 saw signatories agree to amendments aimed at improving plastic waste trade regulation and transparency⁷⁵.

⁶⁷ In order, these countries are: China, Indonesia, the Philippines, Vietnam, Sri Lanka, Thailand, Egypt, Malaysia, Nigeria, Bangladesh, South Africa, India, Algeria, Turkey, Pakistan, Brazil, Burma, Morocco, North Korea and the United States; Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. *Science*. 2015 Feb 13;347(6223):768-71. doi: [10.1126/science.1260352](https://doi.org/10.1126/science.1260352)

⁶⁸ National Packaging Waste Database, 2019, Calculated from [2018 Q1, Q2, Q3 & Q4 Packaging Recycling & Recovery Data](#), 29 March 2019

⁶⁹ Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. *Science*. 2015 Feb 13;347(6223):768-71. doi: [10.1126/science.1260352](https://doi.org/10.1126/science.1260352)

⁷⁰ HMRC, 2019, [Trade Statistics](#) Commodity Code HS2-3915 Waste, pairings and scrap of plastic, accessed 27 May 2019

⁷¹ BBC News [Recycling: Where is the plastic waste mountain?](#) 1 January 2019

⁷² Independent [India bans imports of waste plastic to tackle environmental crisis](#), 7 March 2019

⁷³ Financial Times, [Thailand to ban foreign plastic waste from 2021](#), 14 October 2021

⁷⁴ Defra Press Office, 2019 [Plastic waste exports and the Environment Agency's response to electrical waste exports report](#)

⁷⁵ UN Environment, [Governments agree landmark decisions to protect people and planet from hazardous chemicals and waste, including plastic waste](#), 12 May 2019

Table 1. Summary of land- and sea-based sources of marine plastic waste, according to a [2016 briefing paper from the Grantham Institute, Imperial College London](#).

Land-based sources	Sea-based sources
<ul style="list-style-type: none"> • Illegal dumping and inadequate waste management • Industrial activity • Insufficiently filtered wastewater • Coastal littering • Discharge of storm water • Combined Sewer Overflows (CSOs) • Natural disasters 	<ul style="list-style-type: none"> • Fishing • Shipping • Offshore oil and gas platforms, undersea exploration.

4.3 Origins of marine plastics: land vs. sea

Both land-based and sea-based activities contribute substantial quantities of plastics to the marine environment (Table 1).

In most areas of the world, land-based sources of plastic waste are believed to dominate (it is widely cited that 80% of marine plastic waste has a land-based origin, but the origins of this figure are uncertain⁷⁶). However, [a 2015 report from the European Environment Agency](#) concluded that land- and sea-based sources are equally important in the North-East Atlantic sea region (which incorporates the NI coast)⁷⁷. According to [data from the European Commission](#), 60% of plastic litter items at sea in European waters are single use plastics, and a third are items from fishing activities⁷⁸.

Whilst the original use of plastic items can often be identified when debris is new and intact (helpful for identifying a potential source), this becomes more difficult, and often impossible, once plastics fragment and degrade. Therefore, calculating the proportion of smaller plastic fragments attributable to different sources is a major challenge.

4.4 Origins of marine plastics: macroplastic waste vs. primary microplastics runoff

Whilst many microplastics arise from the degradation of plastic waste, others are released into oceans already in the form of tiny fragments (known as 'primary microplastics'). In 2017 the [International Union for the Conservation of Nature \(IUCN\) conducted a major investigation](#) into the extent of the contribution of primary

⁷⁶ Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. *Science*. 2015 Feb 13;347(6223):768-71. doi: [10.1126/science.1260352](https://doi.org/10.1126/science.1260352)

⁷⁷ European Environment Agency, 2015, [State of Europe's Seas](#). EEA Report No 2/2015. p. 83

⁷⁸ European Commission, 2018, [Reducing Marine Litter: action on single use plastics and fishing gear](#). Commission Staff Working Document Impact Assessment. p. 11

microplastics to total marine plastic. It estimates the loss of global primary microplastic into the oceans to be in the order of 1.5 million tonnes per year⁷⁹, which amounts to around 15% of all plastic released into the ocean from land as calculated by Jambeck et al. 2015⁸⁰.

4.5 Illegal waste activity

Various illegal activities have the potential to contribute to plastics in the marine environment. Where waste is mismanaged, it can be free to enter watercourses and, ultimately, the sea. A [2016 investigation](#) by Detail Data into waste management in NI highlighted⁸¹:

- 2 million tonnes of waste in illegal/unlicensed dumps since 2006;
- 6,000 incidents of fly tipping each year;
- 66 illegal sites confirmed (amounting to more than 724,000 tonnes of waste), with another 30 under investigation; and
- 177 convictions for waste offences 2012-2015.

5 Current policies and regulations relating to marine plastics in NI

5.1 Marine litter

UN initiatives

Regulations setting goals and guidelines for general marine environmental quality often specifically refer to reducing pollution and litter. Internationally, the [United Nations Convention on the Law of the Sea \(UNCLOS\)](#) Article 194, signed in 1982 and which came into force in 1994, requires states to prevent and reduce marine pollution from any source. Goal 14 of the [United Nations \(UN\) Sustainable Development Goals](#), adopted in 2015, aims to prevent and reduce all kinds of marine pollution, including marine debris, by 2025. In December 2017, the UK was one of 193 states to sign a [UN Environment Assembly resolution on marine litter and microplastics](#) which established a series of non-binding objectives and the setting up of an expert group.

⁷⁹ IUCN 2017, [Primary Microplastics in the Oceans: a Global Evaluation of Sources](#). p. 19

⁸⁰ Calculated as proportion of total primary microplastic ocean inputs and average land-based plastic inputs from plastic waste – Jambeck JR, Geyer R, Wilcox C, Siegler TR, Perryman M, Andrady A, Narayan R, Law KL. Plastic waste inputs from land into the ocean. *Science*. 2015 Feb 13;347(6223):768-71. doi: [10.1126/science.1260352](#)

⁸¹ Detail Data, [Waking up to waste: How Northern Ireland's waste problem could leave a toxic legacy](#), 7 November 2016

OSPAR Regional Action Plan on marine litter

In 2014, the OSPAR Convention, of which the UK is a signatory agreed a [regional action plan on marine litter](#). The plan targets key land and sea-based sources of marine litter, removal and education in 55 actions to be implemented from 2014-2021.

Marine Strategy Framework Directive

Within the EU, the [Marine Strategy Framework Directive \(MSFD\)](#) requires member states to achieve “good environmental status” in marine environments by 2020 and to monitor and implement improvement measures, according to 11 specific descriptors. Descriptor 10 makes specific reference to marine litter.

In response to the MSFD, the UK Government published the UK Marine Strategy Parts 1-3 between December 2012 and December 2015, setting out its framework for assessing, monitoring and improving the marine environment. A consultation on proposed updates to the Strategy is currently open, due to close in June 2019⁸².

NI Marine Litter Strategy

In NI, the [Marine Litter Strategy](#), launched in 2013, sets out goals to (i) reduce rates of litter entering the marine environment and (ii) remove litter already present.

Sub-strategies include:

- Encouraging appropriate litter disposal by members of the public;
- Enforcing of statutory deterrents (fines);
- Monitoring marine litter in line with MSFD requirements;
- Investment in coastal litter infrastructure; and
- Investment in water treatment infrastructure emptying into rivers and seas.

The Marine Litter Strategy is focused on reducing litter in coastal areas. It does not, therefore, address waste in the seabed or within the water column and does not consider the specific means of waste disposal once litter is removed. A review to the Marine Litter Strategy was expected in 2015, but as yet it has not been produced.

5.2 Disposal of waste at sea

MARPOL Convention

The disposal of plastic waste at sea is regulated through a series of international conventions and agreements. The [International Convention for the Prevention of](#)

⁸² Defra, Welsh Government, DAERA, Scottish Government, [UK updated assessment and Good Environmental Status: Consultation document](#), May 2019

[Pollution from Ships \(MARPOL Convention\) 1973/78](#) is an international convention preventing waste being dumped from ships at sea and requiring state signatories to provide waste disposal facilities in ports. Annex V specifically bans the disposal of all forms of plastic into the sea.

Within the EU, the requirements of the MARPOL Convention have been implemented through directives such as the [Port Reception Facilities Directive](#) (2000, [amended 2015](#)). Penalties for non-compliance with MARPOL are addressed in the [Ship-Source Pollution Directive](#) (2005, amended [2009](#)).

Other international cooperation

Further international regulations relating to waste from ships include:

- [Food and Agriculture Organization of the United Nations \(FAO\) Code of Conduct for Responsible Fisheries](#) (1995) Article 8⁸³ – this requires states to minimise the loss of fishing gear, minimise the taking aboard of potential waste and introduce appropriate waste disposal facilities in harbours; and
- [London Convention \(1996\) and London Protocol \(2006\)](#) – these ban disposal of persistent plastic and other synthetic materials (netting and ropes etc.) at sea. They also ban export of waste for dumping at sea.

5.3 Land-based waste and single-use plastics

Waste Framework Directive

The EU [Waste Framework Directive \(WFD\)](#) requires member states to establish national waste management strategies and identify key products responsible for littering locally. National strategies must include targets for re-use and recycling rates from households and the construction and demolition industry. The WFD was transposed into NI legislation through the [Waste Regulations \(Northern Ireland\) 2011](#).

NI Waste Management Strategy

Within NI, the Department of the Environment (now DAERA) produced its first Waste Management Strategy in 2000, most recently [updated in 2013](#) to align with WFD requirements. Objectives include:

- Development of a Waste Prevention Programme – launched in 2014 as [The Waste Prevention Programme for Northern Ireland – The Road to Zero Waste](#);
- Extension of the Carrier Bag Levy;

⁸³ Food and Agriculture Organization of the United Nations. [Code of Conduct for Responsible Fisheries](#). Fisheries and Aquaculture Department.

- Separate collections by material for recycling (to improve quality of recycling materials); and
- Specific recycling targets, including to recycle 72.7% of packaging waste by 2017.

Circular Economy Package

The EU [Circular Economy Package](#), as proposed in 2015, sets out a new suite of measures aiming to facilitate the transition of the EU towards a more 'circular economy' (in which waste is repurposed as a resource, as opposed to the traditional approach of 'make, use, dispose'⁸⁴). The package was [formally agreed by the European Council in May 2018](#) and includes proposals for new directives on waste, packaging and landfill, as well as new, more ambitious recycling targets.

The [Single Use Plastics Directive](#), an integral part of the Circular Economy Package and the EU Plastics Strategy, was passed by the European Parliament in March 2019⁸⁵ and was adopted by the Council in May 2019⁸⁶. It is expected to come into force from 2021. The Directive includes provisions for:

- A ban on a number of specific single-use plastic products: plastic cotton bud sticks, plastic cutlery, plates, straws, stirrers, balloon sticks, oxo-degradable plastics and expanded polystyrene (EPS) food containers and cups;
- Extended Producer Responsibility schemes paid for by manufacturers to finance costs of clean-up of products such as cigarette filters and fishing gear;
- Measures to reduce consumption e.g. improved labelling; and
- 90% separate collection target for plastic bottles by 2029 (77% by 2025).

The next stage of the adoption of the Directive will see the texts published in the Official Journal of the EU, 20 days after which the Directive will come into force. Member states will then have two years to implement national legislation on product bans, five years for requirements to tether caps and lids to beverage containers, and extended producer responsibility requirements will need to be implemented between January 2023 and 31 December 2024.

NI legislation on specific plastic products

Two pieces of legislation currently regulate specific plastic products in NI:

- [Single Use Carrier Bags Charge Regulations \(Northern Ireland\) 2013](#) - stipulates levy on sale of all single use carrier bags; and

⁸⁴ For more information on circular economies see POSTnote 536, 2016 [Designing a Circular Economy](#)

⁸⁵ European Commission, 2019 [Statement: Circular Economy: Commission welcomes European Parliament adoption of new rules on single-use plastics to reduce marine litter](#), 27 March 2019

⁸⁶ European Commission, 2019 [Press Release: Circular Economy: Commission welcomes Council final adoption of new rules on single-use plastics to reduce marine plastic litter](#), 21 May 2019

- [Environmental Protection \(Microbeads\) Regulations \(Northern Ireland\) 2019](#) - bans microbeads in rinse-off personal care products.

Since the introduction of the plastic bag levy, the number of plastic bags issued annually has dropped from around 300 million in 2012, to under 100 million from 2013 (Figure 10).

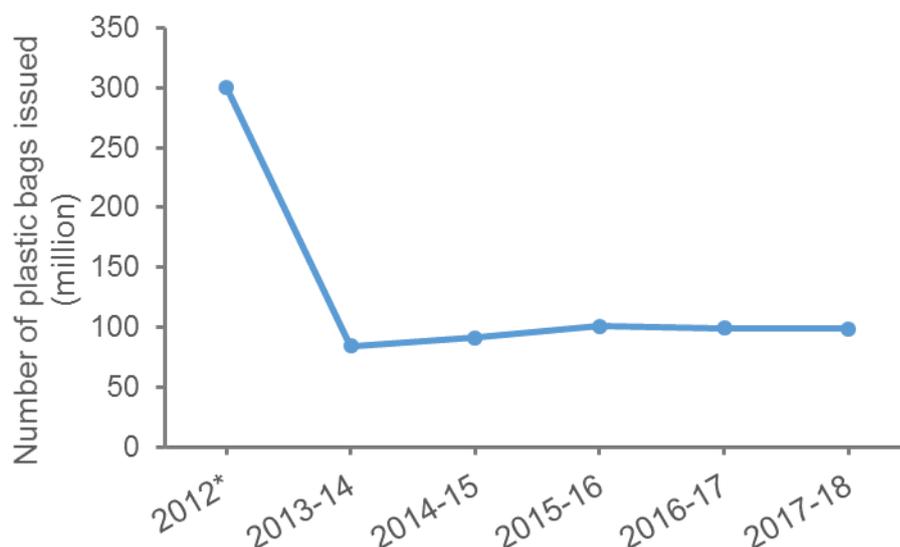


Figure 10. Plastic carrier bags issued in NI from 2012-2018. The carrier bag charge was introduced in 2013 and extended in 2015. * estimated figure for 2012 calendar year. Data from DAERA, 2019⁸⁷.

Further legislation, in the form of [The Litter \(Northern Ireland\) Order 1994](#) , [The Clean Neighbourhoods and Environment Act \(Northern Ireland\) 2011](#) and a series of NI statutory rules, regulates against waste being left in public spaces. Under the [2012 Code of Practice on Litter](#), local councils are responsible for removing litter on 'amenity beaches' during the bathing season (1 May to 30 September inclusive).

5.4 Water treatment

Urban Waste Water Treatment Directive

The EU Urban Waste Water Treatment Directive establishes regulations on the collection and treatment of urban waste water and is implemented in NI under the [Urban Waste Water Treatment Regulations \(Northern Ireland\) 2007](#).

Regulations state that sewage should receive at least primary treatment to remove 50% of solid waste before discharge into water bodies. Whilst this may remove some of the larger plastic items which frequently enter waste water systems (nappies,

⁸⁷ DAERA, 2019 [Northern Ireland carrier bag levy statistics](#)

sanitary products), wastewater treatment works are not generally equipped to remove smaller particles and microplastics. The Chartered Institution of Water and Environmental Management (CIWEM) reports, from a number of studies, that sludge produced in waste water treatment can contain 99% of the microplastics in the waste water stream⁸⁸, which in turn is often applied as fertiliser on agricultural land, which could in turn wash back into water courses.

6 Recent policy developments for marine plastics in NI

DAERA and the UK and Welsh governments have produced for consultation a series of proposed UK-wide measures to address plastic waste. The consultation closed in May 2019, and some of the measures are as follows:

- [Deposit Return Scheme \(DRS\)](#) – proposal to introduce a DRS in England, Wales and NI (to be compatible with a DRS in Scotland, which has carried out a separate consultation). The scheme would apply specifically to drinks containers made of polyethylene terephthalate (PET) and high density polyethylene (HDPE) plastics, as well as steel and aluminium cans and glass bottles. A deposit would be added to the cost of drinks at the point of purchase, which could be refunded once the empty container is returned to an approved return point. Drinks products with eligible packaging would be mandated to join the scheme.

The scheme would exempt any containers for milk or similar plant-based drinks, on the basis that a milk-type product “is considered by many as an essential product which is only widely available in containers”. Recycling charity RECOUP [estimates that 13 billion plastic bottles are used every year](#) and the British Plastics Federation states that around [4 billion of these are HDPE plastic milk bottles](#). Therefore, the exclusion of milk bottles means that almost a third of plastic bottles would be ineligible to be part of the scheme.

In May 2019, the Scottish Government confirmed that it would go ahead with its new DRS⁸⁹, which would be integrated with a UK-wide scheme. Across Europe, 130 million people live in countries which operate a DRS. Environmental think tank Green Alliance considers a plastic bottle DRS to be the single most effective action government could implement to reduce marine plastics⁹⁰.

N.B. – past proposals of a DRS in NI: Glass bottle return schemes have existed in NI in the past, but these grew unpopular as packaging production became cheaper. In 2015, after the publication of a [feasibility study in Scotland](#), the then Environment Minister [Mark H. Durkan expressed intentions to reintroduce a DRS](#) for bottles in NI.

⁸⁸ CIWEM, 2017, [Addicted to plastic: microplastic pollution and prevention](#), p.11

⁸⁹ Scottish Parliament, 2019, [Official Report, Meeting of the Parliament Wednesday 8 May 2019](#)

⁹⁰ Green Alliance, 2017, [How to stop nearly two thirds of plastic getting into the sea](#)

However, an options paper commissioned subsequently by DAERA concluded that a DRS was not feasible on a NI-only basis^{91, 92}.

- **Plastic Packaging Tax** – in the Budget 2018, the UK Government announced plans to introduce a tax on plastic packaging containing a low proportion of recycled material, to begin in 2022. The tax aims to create demand for recycled plastics by incentivising businesses to use more recycled materials in their products. The tax would apply only to plastic packaging with less than 30% recycled content and would cover all UK-manufactured packaging and unfilled packaging imported to the UK.
- [Reform of the producer responsibility system](#) – the current UK-wide producer responsibility system, which began in 1997, requires businesses which handle at least 50 tonnes of packaging materials or products annually, and have a turnover of more than £2 million per year, to contribute towards meeting UK recycling targets. This is most often achieved by signing up to an approved compliance scheme which in turn gathers evidence to show that required quantities of waste have been recovered and recycled. Proposed reforms look to require packaging producers to pay the “full net cost” of managing packaging waste (the current scheme only pays for around 10% of this cost). This would include costs incurred in collection, transport and sorting.

In their recent report, [Fixing fashion, clothing consumption and sustainability](#), the Environmental Audit Committee recommended extending the reformed system to the textile industry, and [Defra](#) has indicated that they intend to do so.

The UK Government has also proposed additional funding to support waste reduction research⁹³:

- A further £20 million (in addition to the £20 million already in place in the Plastics Research and Innovation Fund – PRIF) pledged in the Budget 2018, to be split equally between plastics research and development, and recycling and waste management technology.

7 Current and future policies elsewhere in the UK and in the RoI

Just as the [Delivering Resource Efficiency – NI Waste Management Strategy](#) was produced in 2013, national waste management strategies have been developed across the UK and the RoI, outlining national policy on waste, resource use and re-use:

⁹¹ Letter from Noel Lavery, Permanent Secretary, DAERA to David Lindsay, Ards and North Down Borough Council [Container Deposit Return Scheme for Northern Ireland](#), 20 December 2017

⁹² [Written question AQW 7290/16-21](#) from Steven Agnew MLA to Michelle McIlveen MLA, Minister of Agriculture, Environment and Rural Affairs, 16 November 2016, answered 29 November 2016.

⁹³ HM Government, 2018, [Our waste, our resources: a strategy for England](#)

- England: [Our Waste, Our Resources: a strategy for England](#) – published 2018;
- Wales: [Towards Zero Waste](#) – published 2010;
- Scotland: [Making Things Last: a circular economy strategy for Scotland](#) – published 2016; and
- RoI: [A Resource Opportunity: Waste Management Policy in Ireland](#) – published 2012.

In recent months, single-use plastics (plastics which are used once before being thrown away) have received considerable attention from governments across the UK. The Scottish Government has pledged to ban plastic-stemmed cotton buds in the 2018-2019 Programme for Government, and the UK Government has announced their intention to ban plastic straws, drinks stirrers and cotton buds in England from October 2019. Whilst levies on disposable drinks cups have been discussed in all the UK nations and in RoI, it only remains under consideration in Wales and Scotland.

As referred above, the Scottish Government has recently confirmed that it will introduce a DRS and the UK Government, Welsh Government and DAERA recently consulted jointly on proposals for a UK-wide DRS (consultation closed May 2019).

Current policy and legislation, as well as key proposals from these strategies and other government announcements, are summarised in Table 2.

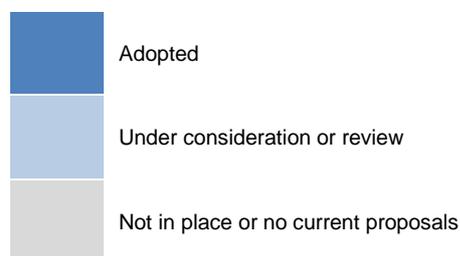
Table 2. Policies related to marine plastics adopted or under consideration across the UK and RoI.

	NI	England	Wales	Scotland	RoI
Littering and fly-tipping penalties					
Plastic bag charge					
Microbeads ban	Ban on 'rinse-off' personal care products	Ban on 'rinse-off' personal care products	Ban on 'rinse-off' personal care products	Ban on 'rinse-off' personal care products	Identified as priority legislation for 2019 summer session ⁹⁴
Producer responsibility scheme	Currently in place – reform proposals consultation closed May 2019 ⁹⁵				

⁹⁴ Office of the Government Chief Whip (RoI) [Legislation Programme Summer Session](#) 2019 2 April 2019

⁹⁵ Defra, Scottish Government, Welsh Government, DAERA [Consultation on reforming the UK packaging producer responsibility system](#) February 2019

	NI	England	Wales	Scotland	RoI
Deposit return scheme (DRS)	Consultation closed May 2019 ⁹⁶			Announced May 2019, start date TBC. ⁹⁷	Included in Waste Reduction Bill 2017 (private members) – currently blocked by government ⁹⁸
Plastic packaging tax	Consultation closed May 2019 ⁹⁹				Proposal scrapped 2013 ¹⁰⁰
Drinks cups levy		Ruled out in Budget 2018 ¹⁰¹	Under consideration ¹⁰²	Government agreed to back levy as part of deal with Scottish Greens to pass Budget 2019-2020 ¹⁰³	Proposal scrapped 2018 ¹⁰⁴
SUP ban (national)		Government committed to ban on plastic straws, stirrers and cotton buds from October 2019 ¹⁰⁵		Ban on plastic-stemmed cotton buds in 2018-19 Programme for Government ¹⁰⁶	Included in Waste Reduction Bill 2017 (private members) – currently blocked by government ¹⁰⁷
SUP ban (government offices)		Pledged to remove consumer SUPs from central government buildings by 2020 ¹⁰⁸	Aim for no single-use plastic in government offices by 2021 ¹⁰⁹	Single use coffee cups banned in government offices ¹¹⁰ , and straws banned in Parliament ¹¹¹	Government offices, public bodies, state agencies, schools ¹¹²



⁹⁶ Defra, Welsh Government, DAERA [Consulting on introducing a Deposit Return Scheme in England, Wales and Northern Ireland](#) February 2019

⁹⁷ Scottish Government [Deposit Return Scheme](#), 8 May 2019

⁹⁸ Irish Independent, [Proposed law to ban single-use plastics blocked by Government](#), 29 May 2019

⁹⁹ HM Treasury [Plastic packaging tax: consultation](#), February 2019

¹⁰⁰ The Irish Times, [Minister for Environment scraps plans to introduce packaging levy](#), 12 September 2013

¹⁰¹ HM Treasury [Budget 2018](#) October 2018

¹⁰² Welsh Government, 2018 [Developing new Welsh taxes](#)

¹⁰³ Scottish Government, 2019 [Scottish Budget 2019-20 Stage 1 Scottish Greens Agreement letters](#)

¹⁰⁴ Houses of the Oireachtas, [Dáil Éireann debate](#), 25 April 2018

¹⁰⁵ HM Government, 2019 [Press release: Gove takes action to ban plastic straws, stirrers, and cotton buds, 22 May 2019](#)

¹⁰⁶ Scottish Government, 2018 [Programme for Government: First Minister's speech](#)

¹⁰⁷ Irish Independent, [Proposed law to ban single-use plastics blocked by Government](#), 29 May 2019

¹⁰⁸ HM Government, 2019 [Our Waste, Our Resources: A strategy for England](#)

¹⁰⁹ "...I am committed to ensuring Welsh Government offices are single-use plastic free by the end of this Assembly term", Hannah Blythyn AM, Minister for Environment – National Assembly for Wales, 2018 [Plenary 08/05/2018](#)

¹¹⁰ Scottish Government, 2018 [Action on single-use items](#), 30 May 2018

¹¹¹ Scottish Parliament, 2018 [Scottish Parliament building banishes plastic drinking straws forever](#), 2 February 2018

¹¹² Department of Communications, Climate Action & Environment, 2019 ["Minister Bruton Announces Government will Lead the Way in Reducing Single Use Plastics"](#) Press Release

8 Marine plastics policies in the rest of the world

8.1 Policies on plastic production and use

UNEP report: Legal Limits on Single-Use Plastics and Microplastics

Legislation specifically addressing the issue of plastic waste and pollution is increasingly common across the world. Of these, regulation of plastic carrier bags, SUP products and packaging, and deposit return schemes are amongst the most common. In 2018 the UNEP launched [a report summarising legal actions](#) across the world on plastic bags, SUPs and microplastics. Table 3 summarises these policies.

Table 3. Summary of international legislation on plastic production and use (single-use plastics (SUP), extended producer responsibility and mandatory deposit return schemes, microbeads, plastic bags). Adapted from: UNEP 2018¹¹³.

Items (part of supply chain regulated, where applicable)	Countries
POLICIES NOT CURRENTLY ADOPTED IN NI	
SINGLE USE PLASTICS (SUPs)	
Ban on specific plastic materials	
Polystyrene products (Manufacture, import, use, sale, distribution)	Antigua and Barbuda, Haiti, Guyana, Marshall Islands, Saint Vincent and the Grenadines, Seychelles, Sri Lanka, Tuvalu, Vanuatu, Zimbabwe
Rigid foam plastic produced through use of CFCs and HCFCs (Manufacturing, use, import)	Canada
Plastics items made from <40% 'bio-based' materials (Manufacture, distribution, sale)	Monaco (utensils only)
Non-biodegradable plastic products (Manufacture, import, sale, use)	Pakistan (Islamabad Capital Territory)
Polypropylene and polyethylene products (Manufacture, advertising, sale, import, use, distribution)	Saudi Arabia, Sri Lanka
Plastic packaging thicker than 30 micrometres (Manufacture, distribution, use, import)	Zimbabwe
Ban on specific plastic products	
Packaging (Production, import, marketing, distribution)	Burkina Faso, UAE
Cups/glasses (Import, manufacture, sale, distribution)	France, Marshall Islands, San Marino (at public events)
Plates (Import, manufacture, sale, distribution)	France, Marshall Islands, San Marino (at public events)
Cutlery (Manufacture, import, distribution, sale)	San Marino (at public events), Seychelles

¹¹³ UNEP, 2018 [Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations](#)

Items (part of supply chain regulated, where applicable)	Countries
Cotton buds (Manufacture, sale, distribution)	France, Italy
Plastic banners	Mauritius
Straws (Manufacture, distribution, use)	Vanuatu
Regulation of production/distribution	
Permits for plastic bottle production and import	Fiji
Regulations to minimise plastic use in packaging design	Lichtenstein
Regulations to facilitate reuse or recycling	Malta
Controls on import (polystyrene)	Sri Lanka
Tax on single use plastics	
Packaging	Antigua & Barbuda, Benin, Bulgaria, Croatia, Denmark, Estonia, Finland, Hungary, Italy, Latvia, Lesotho, Lithuania, North Macedonia, Montenegro, Norway, Moldova, Uruguay, Uzbekistan
Tableware and kitchenware	Denmark, India, Latvia, Lithuania, North Macedonia, Slovenia
Any plastic product	Jamaica, Morocco, Tunisia
Deposit container fee	Israel, Marshall Islands, Montenegro, Norway, Palau, St Kitts & Nevis, St Vincent & the Grenadines
MANDATORY DEPOSIT RETURN SCHEME (DRS)	
Bottles	Austria, Barbados, Belize, Croatia, Denmark, Estonia, Fiji, Finland, Germany, Iceland, Israel, Kiribati, Montenegro, Netherlands, Norway, Sweden, Switzerland
Reusable packaging	Romania
General containers/packaging	Lithuania, Palau, Venezuela
Tableware and kitchenware	Marshall Islands
Mandatory acceptance of product but no monetary deposit	Uruguay
POLICIES CURRENTLY ADOPTED IN NI	
EXTENDED PRODUCER RESPONSIBILITY (EPR)	
Extended producer responsibility	7 countries in Africa, 9 in Asia & the Pacific, 38 in Europe (incl. UK), 9 in Latin America and the Caribbean
MICROBEADS	
Ban on microbeads in personal care products	Canada, France, Italy, Republic of Korea, New Zealand, Sweden, UK , USA
PLASTIC BAGS	
Ban or restriction (manufacture, retail, distribution, import)	127 countries worldwide (66% of countries), including NI (UK)

8.2 Policies on plastics entering the sea and plastics already in the sea

IUCN report: National Marine Plastic Litter Policies in EU Member States

A [2017 report](#) from the IUCN summarises policy across EU member states relating to marine plastics.

For policies addressing plastics entering the seas, it highlights:

- “No-Special-Fee” or “Indirect fee” systems which allow vessels to dispose of their waste in harbour facilities without incurring extra cost;
- National implementation of the MARPOL Convention principles to prevent plastic waste being dumped at sea;
- National implementation of a number of EU policies e.g. Denmark banning marine littering under its implementation of the MSFD and Greece regulating plastics arising from lost fishing gears under the Common Fisheries Policy;
- Policies addressing land-based sources including landfills and littering, as well as more general waste management strategies; and
- Regional conventions for reducing plastic waste e.g. the influence of the Protocol on the Protection of the Marine Environment of the Black Sea from Land-Based Sources and Activities in Romania.

For policies addressing marine plastic waste already in the marine environment, it identifies:

- Fishing for Litter schemes which provide fishers with bags in which they can collect litter trapped in nets before depositing this waste in ports and harbours (for details of the NI scheme see section 9, below, on *‘Local council industry and voluntary initiatives’*);
- Collection of lost or abandoned fishing nets and other fishing-related waste, and the redesign on fishing gear;
- Funding for research and monitoring for assessing environmental status including quantities of marine litter;
- Monitoring of bathing waters including the assessment of marine litter; and
- Beach and sea clean-ups.

9 Local council, industry and voluntary initiatives

In addition to legislative actions and national state-led initiatives, the range of voluntary, industry and local initiatives has expanded over recent years. Below is a summary of some key projects operating in NI.

9.1 Marine litter

- [Fishing for Litter](#) (initiative by the Local Authorities International Environmental Organisation, KIMO) – scheme which supports fishing boats to collect marine litter caught at sea and deposit on the quayside. Whilst KIMO operates Fishing for Litter operations in Scotland and the South West of England, the Fishing for Litter programme in NI is a stand-alone project affiliated to KIMO, supported by DAERA. In DAERA’s [2018 Better Beaches Report](#), it is reported that over 45 tonnes of litter have been removed from NI waters through the scheme, by 135 participating boats across Ardglass, Kilkeel, Portavogie, with a further 10 vessels joining in Warrenpoint in 2017;
- [Operation Clean Sweep](#) – international initiative with signatories from across all parts of plastic production process (including in NI), aiming for zero loss of plastic nurdles, flakes, powders leakage into the environment;
- Beach cleans (organised by various organisations, e.g. KNIB, [Marine Conservation Society](#); [Surfers Against Sewage](#));
- [Clean Coasts](#) – programme run across the island of Ireland funded by Coca-Cola organising beach cleans (Big Beach Clean) and Clean Coasts Week featuring clean up and educational events; and
- [Seabins](#) – Ards and North Down Borough Council recently purchased three ‘seabins’¹¹⁴ (floating devices which suck in waste from surrounding water). Seabins cost around £3,500 each, can be run for approximately £1 per day and can capture three tonnes of litter per year. So far, one seabin has been installed in Bangor Marina (November 2018), with the remaining two expected to be placed in Bangor Marina and Portaferry. The Belfast Harbour Commissioner has also installed a unit in the Abercorn Basin in the Titanic Quarter, Belfast, operational since February 2019¹¹⁵.

9.2 Single-use plastics

- [Local grassroots groups](#) – e.g. [Zero Waste North West](#) group which has run various campaigns including “Say Naw to Straws” encouraging people to refuse single-use straws in local bars and restaurants and a campaign for local waste reduction locally including jointly commissioning a 2017 feasibility study¹¹⁶ with Derry City and

¹¹⁴ Ards and North Down Borough Council, 2018 [First NI Seabin installed in Bangor](#), 20 November 2018

¹¹⁵ Belfast City Council, 2019 [The use of Seabins to capture plastics in the marine environment](#), People & Communities Committee, 5 March 2019

¹¹⁶ Eunomia, [A Circular Economy/Zero Waste Strategy for Derry City and Strabane District Council](#), 1 November 2017

Strabane District Council, [leading to the adoption of a Zero Waste Strategy by the council](#).

- [SUP bans in public sector offices and facilities](#) – public sector organisations across the UK and Ireland are increasingly adopting in-house SUP bans or levies (e.g. Oxford City Council¹¹⁷, Bristol City Council¹¹⁸, Cork City Council¹¹⁹, Scottish Government¹²⁰, Irish Government¹²¹) Ards and North Down Borough Council passed a motion in November 2017 to recognise the importance of addressing waste reduction and support “an end to single use plastics” and the exact way in which this will be implemented is currently being considered. Belfast City Council are also considering whether to ban certain single-use products¹²².

9.3 Plastics industry

- [UK Plastics Pact](#) – collaboration of organisations from across the plastics industry, retailers and supermarkets, universities, government and non-government organisations (members listed [here](#)), delivered by the Waste and Resources Action Programme (WRAP), launched in April 2018. Targets to be achieved by 2025:
 1. 100% plastic packaging reusable, recyclable or compostable;
 2. 70% of plastic packaging recycled or composted;
 3. Eliminate “problematic or unnecessary” single-use packaging items; and
 4. An average of 30% recycled content in plastic packaging.
- [Plastics Industry Recycling Action Plan \(PIRAP\)](#) – a UK industry action plan established in 2015 to improve collection, sorting and end markets for plastics recycling, delivered by the British Plastics Federation (BPF), PlasticsEurope and Recoup, supported by WRAP. The Plan was originally established to support the target to recycle 57% of plastic packaging by 2017, which was subsequently extended to 2020.
- [UK Circular Plastics Network](#) – a network of plastics users, supported by UK Research and Innovation (UKRI) and funded by the Plastics Research Innovation Fund (PRIF). The network aims to share knowledge and expertise on facilitating a more circular economy by reducing the volume of plastic waste, improve recycling rates, educate and reduce confusion amongst the public about waste reduction and recycling, and showcase innovations relating to plastic waste reduction.

¹¹⁷ Oxford City Council, 2018 [Decision details: Phasing out unnecessary single-use plastics](#), 14 June 2018

¹¹⁸ Bristol City Council, 2019 [Council ends sale of drinks in disposable cups at City Hall](#), 11 March 2019

¹¹⁹ Green News, 2017 [Cork City Council to stop using disposable coffee cups from next week](#), 11 January 2017

¹²⁰ Scottish Government, 2018 [Action on single-use items](#), 30 May 2018

¹²¹ Department of Communications, Climate Action & Environment, 2019 “[Minister Bruton Announces Government will Lead the Way in Reducing Single Use Plastics](#)” Press Release

¹²² Belfast City Council, 2018 [Single-use coffee cups & plastic items on Council sites](#), 22 June 2018