

# The plastic bottle cap report

*Findings of the first survey into plastic bottle cap pollution on beaches in the Netherlands*

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**The North Sea Foundation**

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# Summary

Billions of plastic bottles are sold and opened every day and many of the bottle caps end up in our oceans and on our beaches. Marine mammals, birds and fish see plastic bottle caps as food, which can lead to ingestion and potentially fatal consequences. Many plastic bottle caps can also be found in the North Sea. This report presents the findings of The North Sea Foundation's first 'bottle cap survey'. This is the first time that pollution from plastic bottle caps has been researched this thoroughly.

This bottle cap survey shows the quantity, type and origins of the bottle caps that pollute the North Sea and its beaches. This research is important for successfully addressing this pollution at its source.

In the summer of 2016, The North Sea Foundation and more than 2,000 volunteers picked up as many bottle caps as they could find along the entire Dutch North Sea coast. These bottle caps were analysed one by one. These are the most important findings of that analysis:

1. 10,004 bottle caps were collected from the Dutch North Sea coastline during the 2016 Boskalis Beach Cleanup Tour
2. more than 80% came from consumer drinks and food packaging<sup>1</sup>
3. the most common bottle cap colours that were found were blue and white
4. 80% of the bottle caps had no brand
5. more than 70% were damaged, ranging from slight to severe damage. This may indicate that the bottle caps had been floating at sea for a long time
6. the number of bottle caps found on the beach per kilometre numbered between 20 and 128.

The following conclusions on the issue of worldwide bottle cap pollution were drawn from a survey of literature:

7. bottle caps are among the top 5 items found during beach cleaning and beach litter monitoring around the world
8. over the last 30 years, more than 20 million bottle caps and lids were found during beach cleaning activities around the world. Currently, it is unknown how many bottle caps actually enter our oceans and wash up on shore
9. plastic bottle caps are made of hard plastics and degrade very slowly
10. plastic bottle caps are among the top 5 ocean trash items that are deadly for sea life.

Plastic bottle caps do not belong in the sea. The North Sea Foundation advocates for dealing with bottle caps at the source and for good waste management on land and at sea. To deal with bottle cap pollution, The North Sea Foundation suggests the following solutions by sector:

1. government: introduce deposits for disposable plastic (single-use) drink packages, including the caps
2. industry: develop new types of packaging so that plastic leakage will no longer be a problem
3. consumers: use as many reusable bottles and caps as possible, and dispose of waste properly.



## Introduction

The North Sea Foundation has organised the Boskalis Beach Cleanup Tour every year since 2013. The entire Dutch North Sea coastline is cleaned by volunteers over a two week period. Since 2013, 6,335 volunteers have collected 57,426 kilos of litter. This beach cleaning operation allows The North Sea Foundation to reach a wide public and draw attention to the issue of (plastic) pollution in the North Sea and on its Dutch coastline.

Every year, about 8-12 million tons of plastic enters our oceans (Jambeck et al., 2015; Eunomia, 2016), including many plastic bottle caps. The North Sea also contains large numbers of plastic bottle caps. Research carried out by The North Sea Foundation on beach litter over the last 12 years shows that on average, 19 bottle caps are found every 100 metres, mostly on non – touristic beaches<sup>2</sup>. During the annual beach litter monitoring, bottle caps are counted, however little is known about the type of bottle caps that are found. Obtaining this information would give a better understanding about the use and origin of the caps and their movements at sea. It would also mean being able to deal with bottle cap pollution at its source more effectively.

Since 2013, The North Sea Foundation has organised the Boskalis Beach Cleanup Tour. For a two week period, groups of volunteers clean the entire Dutch North Sea coastline. In 2016, 2,320 volunteers collected more than 19,000 kilos of litter. The volunteers in 2016 were requested to separate the bottle caps in order to obtain a better picture of the bottle cap pollution on the Dutch North Sea coast. In total, 10,004 bottle caps were counted, categorised and analysed in The North Sea Foundation's bottle cap lab. This report describes the findings of this unique survey and provides an insight into the worldwide bottle cap pollution.

### *Why is this research important?*

Detailed information is needed to successfully deal with bottle cap pollution on our coastlines and in the sea. The North Sea Foundation hopes that this report will foster greater awareness about the origins and the scale of (plastic) pollution of our oceans. Plastic does not belong in the sea. Plastic bottle caps do not belong in the sea. The North Sea Foundation advocates for dealing with the issue at the source, and for good waste management on land and at sea. A clean and healthy sea is crucial for all marine life.

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<sup>2</sup> The Dutch Ministry of Environment and Infrastructure has assigned the North Sea Foundation to conduct beach litter monitoring according to the OSPAR protocol. Every quarter the North Sea Foundation monitors the four designated non-tourist Dutch beaches over a length of 100 meters (from the dune edge to the sea). By conducting monitoring on non – touristy beaches, a good understanding of the marine litter that floats in the North Sea and eventually washes ashore is being achieved. Beach surveys performed according to the protocol are used to monitor trends in amounts (quantitative), materials (quantitative), and sources (qualitative) of marine litter washed ashore.

## Background to bottle cap pollution

Plastic caps are used all over the world in all sorts of sectors. A large proportion of these caps are not recycled and end up in landfills, or in the sea. The uncontrolled spread of plastic waste is called 'plastic leakage'. Plastic caps wash up on beaches all over the world, including beaches in the Netherlands.



### Plastic caps float and degrade very slowly

GESAMP, the scientific agency of the International Maritime Organisation, has carried out research into the most commonly found waste items in the world-wide 'plastic soup'. It looked at the material, the applications (common application) and buoyancy (gravity). Plastic caps are made of polypropylene (PP) and polyethylene (HDPE or PE-HD). These are hard plastics that degrade very slowly in seawater. Furthermore, polypropylene caps are highly buoyant (GESAMP, 2015). If a bottle with a cap enters the sea, the cap is very likely to become detached from the bottle. This is because the bottle is made from a different type of plastic, polyethylene terephthalate or PET, and is usually thinner and thus can degrade quicker than the cap. However, when plastic bottles fill up with sea water and sink to the seafloor, degradation can be very slow. Individual pieces of PET bottles also sink, given that the material is heavier than the material of which the caps are made (UNEP and GRID Arendal, 2016). The buoyant caps remain at the surface of the water and are spread around the world by the wind, waves and currents.



### Plastic caps wash up on beaches around the world

During the International Coastal Clean-up, organised every year by Ocean Conservancy (OC), thousands of volunteers clean beaches in various countries. Over the past 30 years, data from these clean-ups, show that plastic caps<sup>3</sup> are the third most found item. During this period, more than 20 million caps have been found (see Table 2). OC's data shows that, on average, between 800,000 and one million plastic caps and lids are found every year. In 2015, plastic caps were among the top five most found items, at an average of 21 caps per kilometre cleaned coastline.

#	Type waste product	Number of items found
1	Plastic & paper: cigarette butts	63.355.828
2	Plastic: sweet, crisps & snack packaging	20.799.315
3	Plastic: caps & lids	20.262.369
4	Plastic: drinking bottles	14.624.693
5	Plastic: cutlery, plates and cups	14.283.883
6	Plastic: bags	12.449.384
7	Glass: bottles	9.265.944
8	Plastic: straws & stirrers	8.858.112
9	Metal: tins	8.576.292
10	Plastic: nets, rope	4.062.673

Table 1. Top 10 items found between 1985 – 2015 during the International Coastal Cleanup. Source: Ocean Conservancy, 2017.

<sup>3</sup> Between 1985 and 2016, caps and lids were registered in the same category during the International Cleanup Day. From 2015 onwards, the caps were registered separately. In 2015, 861,340 plastic caps were collected from 40,539 kilometres of coastline.





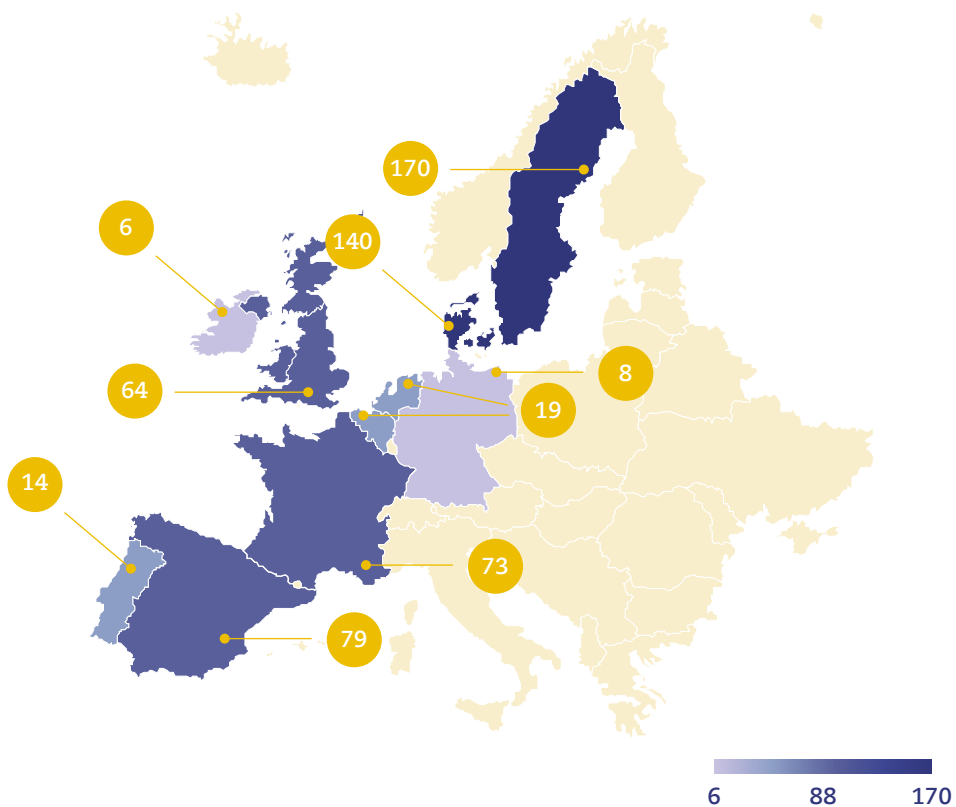
### Plastic cap pollution in OSPAR countries

In 1998 the convention for the protection of marine environment of the North-East Atlantic Ocean entered into force. It was signed and ratified by 15 countries (Belgium, Denmark, Germany, Finland, France, Ireland, Iceland, Luxembourg, The Netherlands, Norway, Portugal, Spain, United Kingdom, Sweden and Switzerland). Various OSPAR<sup>4</sup> countries started monitoring their beaches in 2000 to get a better understanding of the beach litter that wash up on the beaches of the North East Atlantic Ocean. An international beach litter monitoring guideline was developed to monitor beach litter. Items are counted and recorded on a standardised form. The standard form is used by 11 countries in the North East Atlantic Ocean region – the Netherlands, Belgium, Germany, United Kingdom, Sweden, Denmark, Norway, France, Spain, Portugal and Ireland.

Plastic caps fall under OSPAR's category number [15] 'Caps & lids', and are recorded during every beach monitoring activity. Plastic bottle caps constitute a large part of this category. The average number of caps recorded for each 100m of beach, for each OSPAR country<sup>5</sup> is provided in Annex 2. Between 2004 and 2015, 1,561 beach litter surveys carried out in 56 locations found more than 90,000 caps.

## Average number of plastic caps found per 100m of beach

Figure 1. Average number of plastic caps found per 100m of beach on OSPAR Beach litter survey sites in the OSPAR region between 2004 and 2015 (Source: The North Sea Foundation, 2017)



4 The OSPAR Commission (consisting of 15 countries) adopted the Regional Action Plan (RAP) Marine Litter in 2014. The plan describes actions and measures to achieve common goals in the OSPAR region for reducing marine litter and to achieve and maintain the good environmental state and environmental goals under the European Marine Strategy Framework Directive (Appendix 4).

5 The raw data available through the OSPAR database that is hosted and maintained by Marine Conservation Society is used. Absolute amounts of bottle caps are used and have not been statistically analysed. Only the OSPAR sites that carried out more than 15 monitoring activities between 2004 and 2015 are included in this review. Source: Stichting De Noordzee, 2017.



Most plastic caps were found in the United Kingdom (39,543 in 614 surveys) followed by Sweden (18,556 in 109 surveys) and Spain (15,188 in 192 surveys). Figure 1 shows the average number of caps found per 100m of beach. On average, the highest number of caps were found in Sweden (170/100m) followed by Denmark (140 /100m), Spain (79/100m) and France (73/100m). The high average in Denmark was caused by the large numbers of caps that washed up in 2015. Several winter storms were followed by a survey in Skagen in the spring of 2015, where more than 1,400 caps were collected on a 100m stretch of beach. In the case of Sweden, given its location and the currents that converge here, relatively large amounts of litter wash up on its coastline. Of the 167 surveys carried out between 2004 and 2015, the highest number of caps were also found in 2015 (more than 12,000 -see Annex 1).



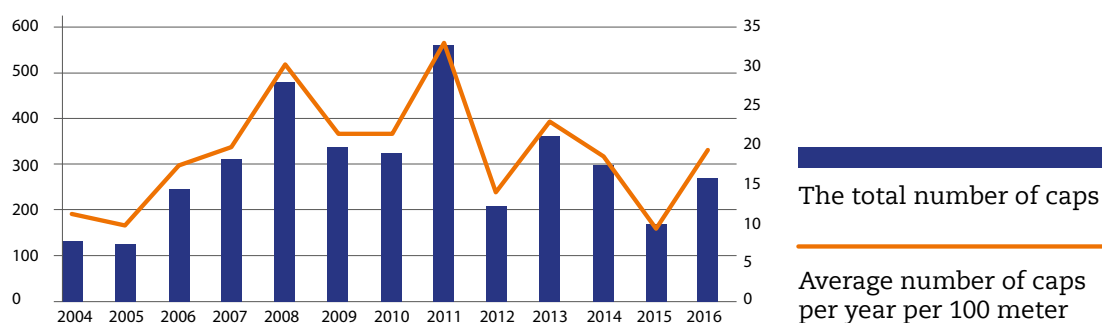
Caps found in Skagen during OSPAR monitoring in 2015. Source: KIMO, Denmark, 2015.

### Caps in the Netherlands

Between 2004 and 2016, an average of 19 caps per 100m of beach were found in the Netherlands. Caps have long been in the top five most found items. There has been no visible declining trend in the number of plastic caps found over the last 13 years (see Figure 2).

### The total number of caps per year

Figure 2. The total number of caps found during OSPAR monitoring in the Netherlands between 2004 and 2016 (Source: The North Sea Foundation, 2017).







“The caps of PET bottles are made from a different type of plastic than the bottles themselves. The caps float while the PET bottles sink. This explains why we regularly find remnants of caps in fulmars’ stomachs while we never find fragments of bottles.”

Jan-Andries Franeker, Fulmar Researcher, Wageningen Marine Research, Wageningen University, the Netherlands.

### Degradation of caps in the sea

The composition and structure of plastic determines its degradation mechanisms. However, the scientific community as yet does not know exactly how these mechanisms work in the marine environment. The Dutch research institute Deltares has carried out laboratory experiments over the last few years as part of the European CleanSea research project. Marine environmental conditions and sunlight were replicated to see how quickly plastics break down and how degradation mechanisms work.

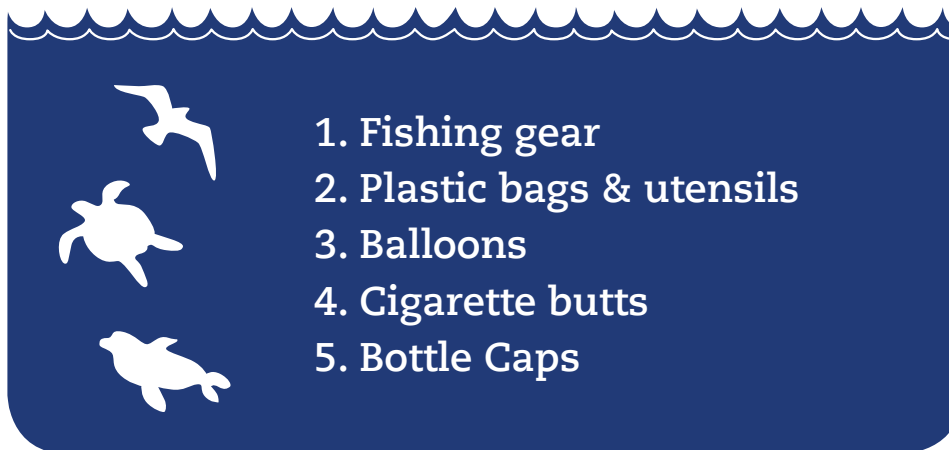
Research has been carried out recently in Greece into the degradation of PET bottles at depths of 150 to 350 metres. It is estimated that a PET bottle remains intact for about 15 years and then breaks down into small pieces of plastic before breaking down further (Loakeimidis, C. et al., 2016). It is thought that the degradation process is much slower for plastic caps made of HDPE/PP which have a different chemical composition and thickness. Studies show that constant heat and sunlight are crucial in the degradation process; factors that are absent in the marine environment.



Simulation of the ‘Plastic Soup’ tank in Deltares’ lab in Utrecht

## Top five most deadly ocean trash item

Figure 3: Top five most deadly ocean trash items. (Source: Ocean Conservancy, 2015)



### Plastic caps cause harm to marine life

The enormous quantity of plastic in our oceans is hazardous for many species of marine animals. Some of the bottle caps will wash up on beaches, but many will remain floating at sea. They will weather and fall apart into ever smaller pieces of plastic. Some will eventually sink to the seabed. Marine mammals, sea turtles, birds and fish can mistake this plastic material for food. More than 690 species ranging from microscopic plankton to whales suffer the negative effects of plastic pollution (Gall & Thompson, 2015). A recent study into the impacts of plastic pollution on sea life – birds, sea turtles and marine mammals, in particular – shows that ingested caps cause harm (Wilcox et al., 2016). Impact is assessed on the basis of: 1) entanglement; 2) ingestion; and, 3) contamination following research and publications from various leading marine litter experts. Plastic caps are among the top five most deadly ocean trash items (Ocean Conservancy, 2015).



Plastic caps found in the stomachs of young albatrosses in Hawaii, 2000. Source: Jan Andries Franeker, Wageningen Marine Research.

### The costs of cleaning up are not only high, but also hidden

Every year in the Netherlands we consume about 1.4 billion plastic bottles, of which 750 million are small plastic bottles with caps (Dutch Central Government, 2017). The plastic packaging currently on the market is very cheap. The cheapest cap costs less than half a euro cent (Alibaba, 2017). While these costs can be quantified, the costs of cleaning, collection, recycling and waste processing often remain hidden. The costs of cleaning up litter (i.e. beach and street) in the Netherlands is estimated at 250 million euros a year (Milieu Centraal, 2015). It is difficult to estimate the economic impact of litter in the sea and on beaches because these are made up of direct costs, such as cleaning, and indirect costs, such as damage to ecosystems and the loss of cultural values such as recreation and landscape aesthetics (Newman, S. et al. 2015).

### The plastic society

Plastic production has skyrocketed over the last few decades, and there is no predicted decrease of this production in the foreseeable future. Consumers have become used to this useful and cheap material. Plastic has become a part of almost every consumer product. About 311 million tons of plastic is produced worldwide every year (Ellen MacArthur Foundation, 2016). A quarter of this is for packaging purposes. Only 14% of packaging materials are recycled and almost a third leaks into the environment and pollutes our cities, beaches and oceans. In 2014, 530 billion PET bottles were produced worldwide. This number is expected to rise by 4.7% every year (Euromonitor International, 2015). In 2016, one of the world's largest cap manufacturers produced 78 billion caps; enough to cover the surface area of the Netherlands one and a half times.

## Annual consumption of plastic bottles in the Netherlands: 1,4 billion plastic bottles per year

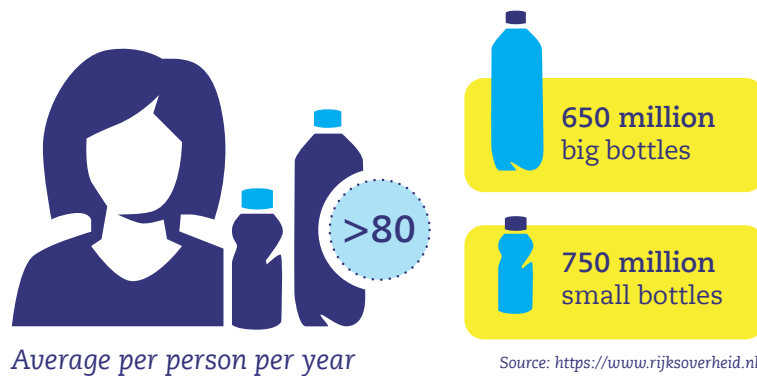


Figure 4: Annual consumption of plastic bottles in the Netherlands (Dutch Central Government, 2017).

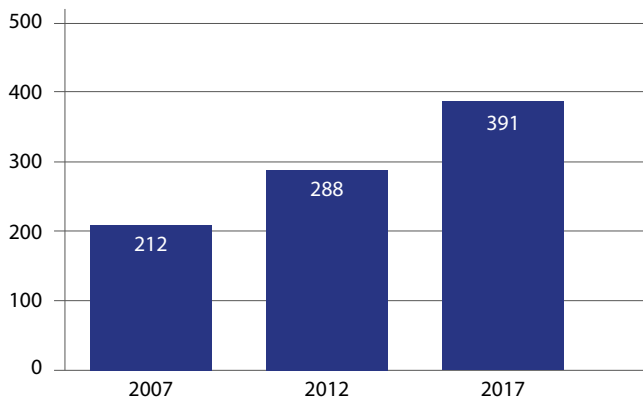


### The growth in demand for bottled water

Over the last 15 years, sales of bottled water have grown enormously. In 2012, more than 250 billion litres of bottled water were consumed worldwide (Statista, 2016). The forecast is that consumption will exceed 350 billion this year (Figure 5). This will result in an increase of both bottle and bottle cap production.

### The worldwide consumption of bottled water

Figure 5: The worldwide consumption of bottled water in billions of litres (Statista, 2016).



Volunteers collecting plastic caps during the Boskalis Beach Cleanup Tour

# The most important findings of the bottle cap survey

During the Boskalis Beach Cleanup Tour 2016, 19,230 kilos of litter was collected from the Dutch coastline, including 10,004 plastic caps. These caps were counted and analysed. This chapter contains the most important findings of the caps survey. The research methodology is outlined in Annex 2.

## *Almost 80% came from consumer drink packaging*

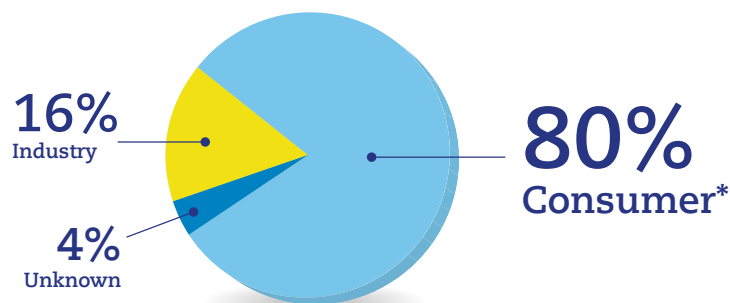
In total, 25 different types of caps were identified (Figure 7). Of the caps found, 79% came from drink packaging. This category includes the protective caps of drinking bottles, PET soft drink or water bottles, Tetra Pak packets such as juice or milk, and yoghurt drink packets.

Given that the rate of return of PET bottles carrying deposits is high in the Netherlands – about 95% of the almost 700 million bottles are returned – it can therefore be assumed that the majority of the caps found are from single use plastic bottles. Besides this, major plastic recycling companies in The Netherlands operate in such a way that drink packaging made of different types of plastics, such as PET and HDPE/PP, can be separated using a floating/sinking method and infrared technology.

A further 14% were different types of caps i.e. tube caps, pull caps and machine caps, sunscreen lotion tubes and jerrycans. Of the caps found, 3% were from food packaging such as ketchup and mayonnaise. In 4% of the cases, the caps collected were either unidentifiable or they had no recognisable use. The origins of the caps could be identified according to type, brand, producer and colour. Identifying the sources of the caps collected, it is estimated that 80% came from consumer groups i.e. groups such as beachgoers and ships' crews; 16% were associated with industrial applications; and 4% came from unidentifiable sources (Figure 6).

## Users/sources of the caps collected

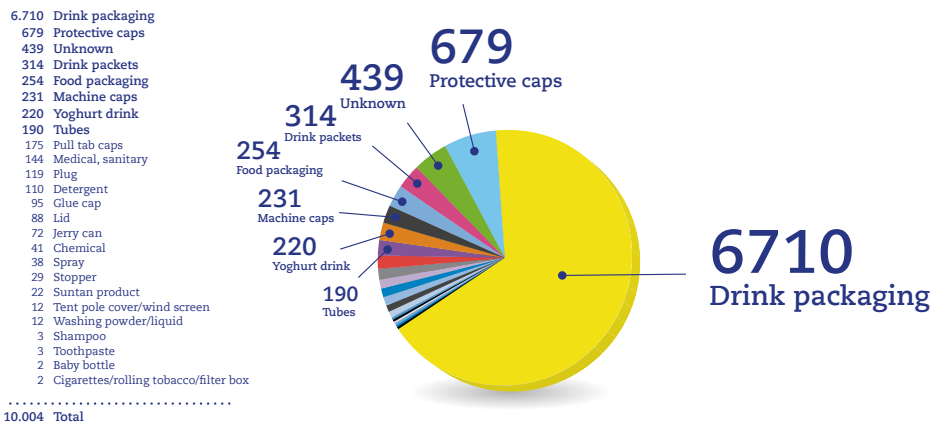
Figure 6: Users/sources of the caps collected. Source: The North Sea Foundation, 2017



\* These are i.e. groups of consumers such as beachgoers and ships' crews

## Type of caps collected

Figure 7: Type of caps collected.  
Source: The North Sea Foundation, 2017

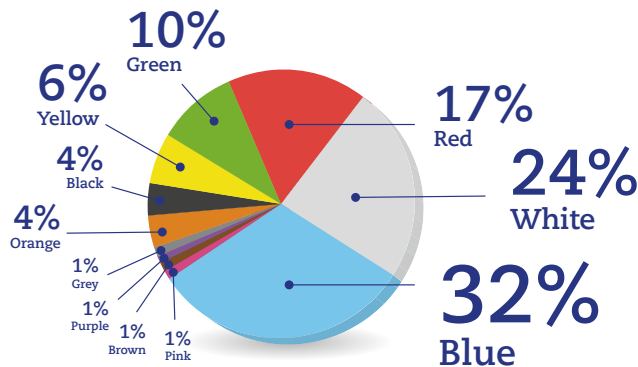


### Blue and white were the most commonly found colours

Of the 11 different colours of caps found, blue (32%) was the most commonly found, followed by white (24%) and red (17%). The remaining 28% were mostly green, yellow, black and orange. Brown and pink were the least frequently found colours.

## Percentage of caps collected by colour

Figure 8: Percentage of caps collected by colour.  
(Source: The North Sea Foundation, 2017)



### 81% of the caps collected are unbranded

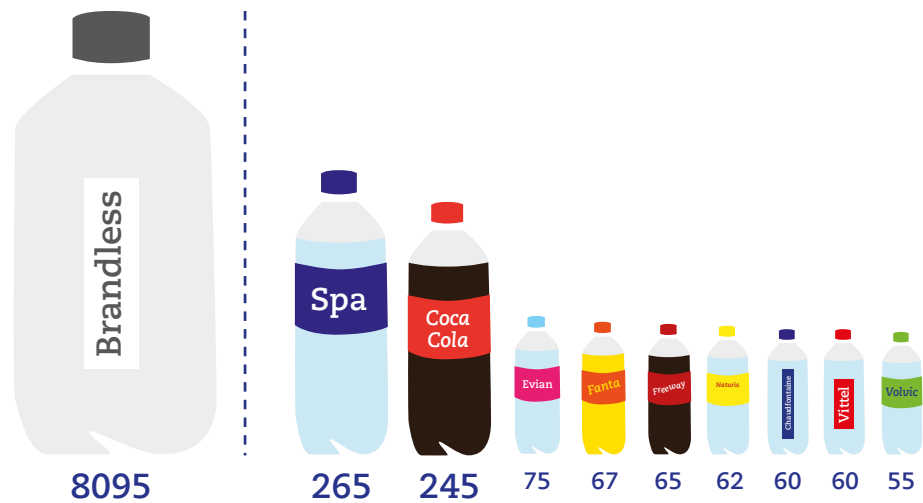
In total, 230 different brands of caps were collected. However, most of the caps (81%) were unbranded and 2% were illegible. The brand was legible on the remaining 17%. Most of the caps were blue unbranded caps from drink packaging. These are assumed to have come from disposable (single use) half litre plastic bottles. The top 10 brands found are given in Figure 9. The top five are: 1) unbranded caps; 2) the mineral water brand, Spa; 3) Coca-Cola; 4) Evian; and 5) Fanta. Most of the Spa caps were found in the beach cleaning stages between Egmond aan Zee–Castricum (province of South Holland), Castricum–Wijk aan Zee (province of North Holland), Wijk aan Zee–Velsen Noord (North Holland). Most of the Coca-Cola and Evian caps were found in the stages on the island of Texel and Huisduinen/ Den Helder–Julianadorp (NH).

For the branded bottle caps, the brands' websites were checked for their countries of sale. It is noteworthy that 93 of the branded bottle caps found are not available for sale in the Netherlands. These include Abbey Well (United Kingdom), Zywiec zdroj (Poland), Baraka (Egypt) and Ganten (China). While it cannot be determined whether these caps originated from land or sea, the assumption is that they originate from ship crews that have discharged, disposed or abandoned waste into the sea.



## The top 10 brands found

Figure 9: The top 10 brands found.  
Source: The North Sea Foundation, 2017



439 caps were illegible. The brands were unidentifiable and they are thus not included in this illustration.

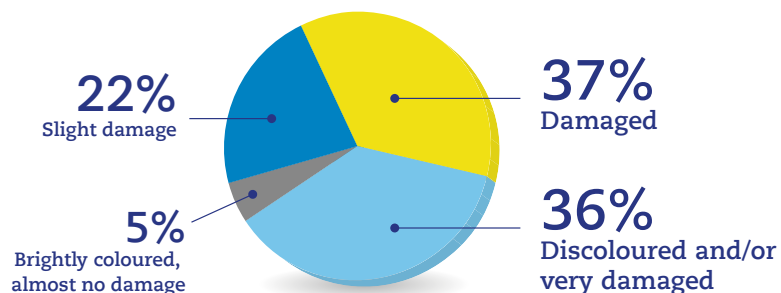
### More than 70% was damaged or very damaged

A majority (73%) of the caps collected were damaged and/or very damaged (Figure 10). It is likely that most of them had been floating at sea for three months or more, and did not originate from the Netherlands. The rest of the caps were either slightly damaged and/or had bright colours and limited damage.

Whether the caps were discarded at sea by the maritime sector (i.e. crews of shipping and fisheries) or from land sources, remains unknown. Further research into the consumption of plastic bottles by the maritime sector is needed in order to draw clearer conclusions. However, what is known is that caps are highly buoyant. Caps originating from land (for example, beachgoers or floating down rivers) are spread quickly by waves, currents and wind. It is likely that the lightly damaged or undamaged caps (27%) come from groups such as beachgoers, people engaged in leisure activities, or from ship crews that discard waste improperly at sea or when they are at anchor.

## Degradation of caps

Figure 10: Degradation of caps.  
Source: The North Sea Foundation, 2017

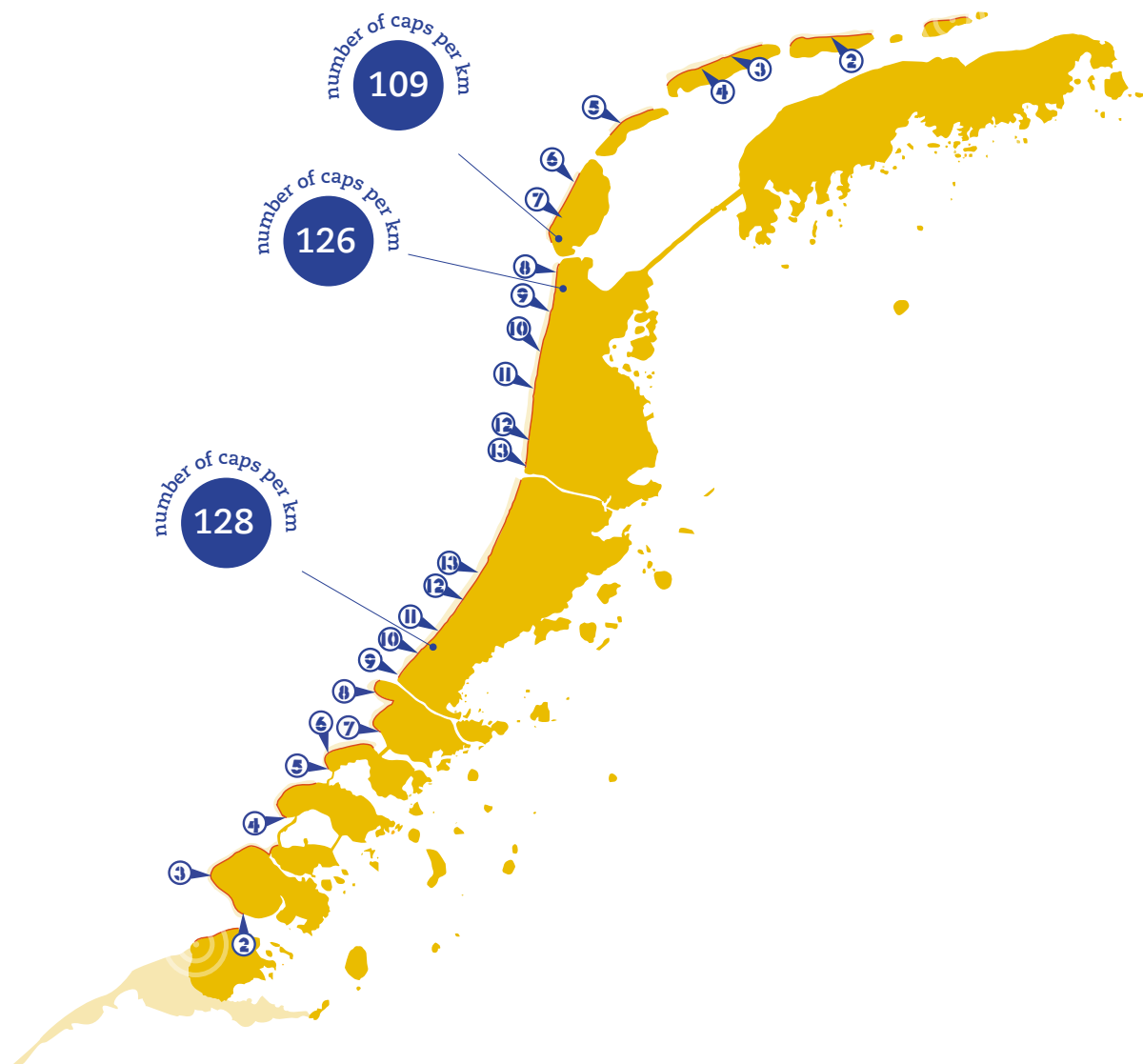


### Between 20 and 128 caps found per kilometre

In order to determine the number of caps collected per kilometre (cap density), the numbers found per kilometre and the length of the stage is recorded. The width of the beach is not taken into consideration. The cap density was calculated to range between 20 and 128 caps per kilometre (Figure 10). The highest densities were in the Monster-Kijkduin (province of South Holland, 5 km, 128 caps per km) and Callantsoog-Petten (province of North Holland, 9 km, 126 caps per km) stages. These stages are in and around the Randstad, the most densely populated area of the Netherlands. The density was lowest (20 per km) in the south, from Cadzand to the Maasvlakte area. This can mean that more caps wash up on beaches north of the country's major rivers. The caps found on stages on the island of Texel and around Den Helder were the least damaged (bright colours, little damage). The hypothesis that more caps wash up north of the rivers will be tested during the next survey.

## The three stages with the highest density of caps per kilometre

Figure 11: The three stages with the highest density of caps per kilometre.  
Source: The North Sea Foundation, 2017





The 10,004 caps collected were used to make five pieces of art, each of which hangs above five donated beach-cleaning containers. The photo shows Doutzen Kroes, international top model, and Tineke Schokker, Mayor of the island of Vlieland, presenting one of the five containers to the local community and beachgoers on the island of Vlieland in December 2016 as part of soft drink producer Rivella's '1 bottle = 1m2' clean beach campaign.

### *70% of the caps did not have recycling codes; 23% had a recycling code nr. 2*

The recycle codes on the inside of the caps were noted for the first thousand caps that were analysed. The plastics industry uses a coding system that helps recyclers sort through plastic products. This system distinguishes between seven types of plastic. The recycling code number usually indicates the type of plastic that the package is made of, so that the plastic can be separated in the waste processing plant for recycling and reuse.

European legislation does not make it mandatory to print recycling codes on caps. Of the first thousand recorded caps, 71% had no recycle code and 23% had code 2 ('high density polyethylene'). Of the remaining caps with legible recycle codes, fewer than 1% had code 3, 1% had code 4 and 1% had code 5. No caps were found with codes 6 and 7.

### *17 different cap producers found*

Whenever legible, the names of the producers inside of the first thousand caps were noted. This analysis identified 17 different producers. The most frequently found producer was Bericap (93). The others included Eurocap, Obrist Cap, Alcoa and Massmould. Bericap is a major producer of a range of caps primarily for drink packaging. However, most of the caps showed no name of producer (85%).





# Recommendations: towards a North Sea free of bottle caps

Most of the caps in the survey came from drink packaging. It is assumed that these are mostly originate from disposable drink packaging given the high recycling percentage of plastic bottles with deposits in the Netherlands and the fact that only a few countries have introduced a deposit system for half-litre plastic drink bottles. To address the issue of bottle cap pollution, The North Sea Foundation proposes three solutions that will tackle the issue at its source. These are: 1) the government introduces deposits on disposable drink packaging (including half-litre bottles, together with their cap); 2) industry is stimulated to design new packaging that will not cause plastic leakage; and 3) encourage behaviour change among consumers to use reusable bottles – and their caps – as much as possible, and to dispose of their litter properly.

## *Government: introduce a deposit system for plastic bottles with caps*

Extending the deposit system to half-litre plastic bottles with caps will result in less litter and thus fewer plastic caps in sea. Waste removal costs will decrease and it will stimulate the circular economy in which secondary raw materials are reused as much as possible.

The Netherlands currently has a deposit system for bottles of one litre or more that works well. At least 95% of the almost 650 million large plastic bottles are returned, mostly with the cap attached. These are primarily PET bottles and the deposit is 25 euro cents a bottle. Deposit systems positively influence the behaviour of consumers – they encourage consumers to return plastic bottles and raise awareness that plastic has a value, including a financial one. The current deposit systems are designed to accept bottles with or without caps. They could be adjusted so that the deposit can only be claimed if the cap is attached. This would mean that more caps are returned so that fewer caps end up in the environment. In doing so, not only the plastic bottle, but the plastic caps are given a financial value.

Most countries do not have a deposit system for half-litre soft drink plastic packaging and these are hardly or not recycled at all. Single use plastic packaging is, as the name suggests, designed to be used only once, and after consumption the packaging is practically worthless. Given the high recycling rate of large plastic bottles in the Netherlands, and the fact that so few bottles with deposits are found as litter, it can be expected that introducing deposits on half-litre plastic drink bottles with caps, which are often consumed outside the home, will have the same impact. Germany, Australia, Canada and Denmark have deposits on half-litre plastic soft drink packaging. Research carried out by the German association of packaging market research (Gesellschaft für Verpackungsmarktforschung, GVM) in 2015 shows that the collection percentage of half-litre PET bottles largely parallels other bottles with deposits. In Germany, 97.9% of the bottles with deposits are returned and recycled (GVM, 2015).

## *Industry: innovate*

The first aluminium can was sold in 1935. At the time, the first cans needed to be opened with a special opener. Over the years, developments in packaging made these cans easier to open. Up until the 1970s, the pull tabs of cans came off when the tin was opened and often ended up on the street or in the environment. In 1975, the “stay-on tab” was introduced that did what the name suggests – the ring pull stayed on the can. Could the same be done for drink packaging whereby either the plastic cap remains on the package/bottle, or is made without a cap altogether? Unless drink packaging is disposed of properly, an invention like this would make a huge difference in the number of discarded caps.



Ooho - an edible and compostable drink package made from plants and seaweed that has no plastic cap. Source: Skipping Rock Labs, 2017

### *Packaging should have multiple functions and be reused*

One way to avoid litter and to increase awareness of the value of plastic would be to give packaging multiple user functions or to reuse it. This would mean that disposable packaging would be used longer thus reducing the chance that it ends up in the environment.

Plastic is a 'sustainable' product, in that most plastic products can be used and reused for a long time before they start to degrade. Innovation needs investment, research, and new ways of thinking that break with traditions. There are many possibilities for the plastic packaging industry to develop new types of packaging, to reduce and eliminate plastic leakage into the sea. By giving packaging multiple functions, or "a second life", they will have a positive effect on consumer behaviour and increase awareness of how societies can deal with waste management, reuse and recycling.

*"For more than 50 years, global production and consumption of plastics have continued to rise and there is no doubt that the levels of plastic pollution will continue to increase. We must therefore progress towards new, alternative and environmentally friendly materials. Both industry and government have a responsibility to foster this development".*

Professor Dr. Dick Vethaak, Department of Environment and Health, VU University of Amsterdam

### *Shift the focus from less to better*

Around the world, companies are developing packaging materials that are biodegradable. These are made from a number of materials such as starch and plant-based materials, for example, made from sugar cane and banana peels. While these are interesting developments, these materials depend on several environmental factors such as temperature, sunlight, oxygen and water to biodegrade. The new value chain needs a wider vision that goes from production to end of cycle including the mitigation of plastic leakage.

*"At present, the focus of drinks producers seems to be on reducing the use of raw materials in the production of packaging. To be really innovative, there needs to be collaboration between suppliers, producers, importers, packaging industry, waste management and recycling companies. This is also essential to move closer to a circular economy".*

Karen van de Stadt, packaging expert and co-founder of the Netherlands Institute for Sustainable Packaging, The Netherlands



Various packaging innovations.

### *Consumers: use reusable drinking bottles*

Most discarded plastic caps come from drink packaging, and most of these are from single-use plastic water and soft drink bottles. A 'simple' solution for plastic cap pollution is to consume fewer disposable plastic packaging with caps and to make greater use of reusable drinking bottles. By doing so, fewer plastic caps will end up in the sea. In addition to this, proper disposal of waste will remain necessary.

*“For more than 30 years, International Coastal Cleanup data have offered a snapshot of the most persistent items of debris littering beaches and waterways, globally. This report enables us to delve deeper into the relative sources of bottle cap debris, which we know poses a serious ecological threat, and offers critical data to further inform dialogue and action targeting durable solutions”.*

Nicholas Mallos, Programme Director Trash Free Seas, Ocean Conservancy

### *Action is needed – now and in the future*

The Netherlands is a worldwide leader in waste management and innovation (MVO Nederland, 2014). However, the plastic cap pollution on Dutch beaches and those worldwide, show that more action is needed. The findings in this report show that measures taken nationally, regionally and internationally, including public awareness, have not been significant enough to prevent plastic cap pollution.

The North Sea Foundation challenges governments to introduce plastic bottle deposit systems and the industry to invent new types of packaging that does not cause plastic leakage and challenges consumers to reuse bottles and dispose of litter properly; thus creating a joint effort working towards a circular economy for healthy and clean oceans.

*“Plastic caps are among the top five most commonly found items of litter on beaches worldwide. We hope that this report encourages industry, governments and citizens to help resolve and reduce plastic cap pollution so that we can maintain a clean, healthy ocean and a well-functioning ecosystem, in our beautiful North Sea and other oceans worldwide”.*

Floris van Hest, Director of The North Sea Foundation, The Netherlands

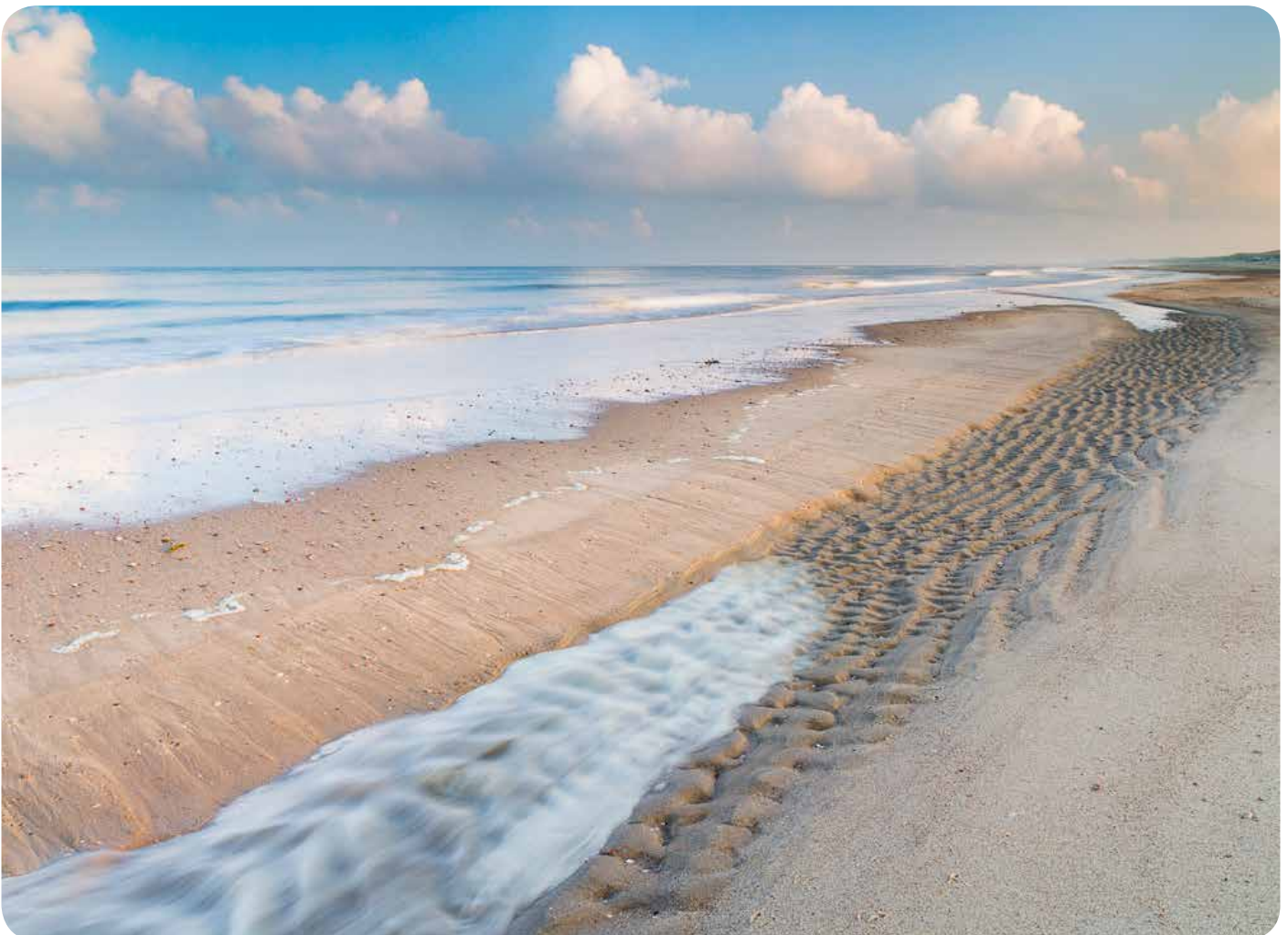
### *Next steps*

This is the first time that research has been carried out on plastic caps on this scale. Some questions remain unanswered in this report. The survey will be repeated in 2017 using the same methodology so that the findings can be compared, any potential trends determined and unanswered questions answered (Annex 3).



# Acknowledgements

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# References

Clean Sea Project. CleanSea final brochure: Policy options for litter-free seas, 2015  
<http://www.cleansea-project.eu/drupal/index.php>

Ellen MacArthur Foundation (2016) The New Plastics Economy: Rethinking the Future of Plastics <https://www.ellenmacarthurfoundation.org/assets/downloads/>

EllenMacArthurFoundation\_TheNewPlasticsEconomy\_15-3-16.pdf

Eunomia, 2016. Study to support the development of measures to combat a range of marine litter sources. Report for European Commission DG Environment

Financial info Bericap, 2016. <http://www.bericap.com/about-us/>

GESAMP (2015). "Sources, fate and effects of microplastics in the marine environment: a global assessment" (Kershaw, P. J., ed.). (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 90, 96 p.

Gesellschaft für verpackungsmarktforschung, 2016. [http://www.forum.et.de/rs/u/files/2016\\_09\\_22\\_Bericht\\_Verwertung%20PET-Getr%C3%A4nkeflaschen%202015.pdf](http://www.forum.et.de/rs/u/files/2016_09_22_Bericht_Verwertung%20PET-Getr%C3%A4nkeflaschen%202015.pdf)

Jambeck, R. et al 2015. Plastic waste inputs from land into the ocean. Published in Science magazine in February 2015.

Journal of Water and Health, 2006. Bottled water versus tap water: understanding consumers' preferences. Miguel F. Doria

M. Hougee & M. Boonstra, 2016. OSPAR Beach Litter Monitoring In the Netherlands

Marine Policy, Volume 65, March 2016, Pages 107–114 Chris Wilcoxa,, Nicholas J. Mallosb, George H. Leonardc, Alba Rodriguezb,, Britta Denise Hardestya, , CSIRO Oceans and Atmosphere Flagship, Castray Esplanade, Hobart, Tasmania 7000, Australia, Ocean Conservancy, Washington DC, USA, Ocean Conservancy, Santa Cruz, CA, USA

Marine Pollution Bulletin, Volume 92, Issues 1–2, 15 March 2015, Pages 170-179 S.C. Gall, , R.C. Thompson

Milieu Centraal, 2015. Zwerfafval (Litter). de Waart, Sytske., de Jong, Wies., Tijss, Margot.

MVO Nederland, 2014. Hoe duurzaam is Nederland? Een analyse van Duurzaamheidvraagstukken in de Nederlandse economie. (How sustainable is the Netherlands? An analysis of sustainability issues in the Dutch economy) ([http://mvonederland.nl/sites/default/files/media/Hoe%20duurzaam%20is%20Nederland%20\(november%202014\).pdf](http://mvonederland.nl/sites/default/files/media/Hoe%20duurzaam%20is%20Nederland%20(november%202014).pdf))

Ocean Conservancy & McKinsey Center for Business and Environment, 2015. Stemming the Tide. <http://www.oceanconservancy.org/our-work/marine-debris/mckinsey-report-files/full-report-stemming-the.pdf>

Ocean Conservancy, 2011. Tracking Trash 25 years of action for the ocean. [http://act.oceanconservancy.org/pdf/Marine\\_Debris\\_2011\\_Report\\_OC.pdf](http://act.oceanconservancy.org/pdf/Marine_Debris_2011_Report_OC.pdf)

OSPAR 2010. Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area. Edition 1.0.

PMMI & Euromonitor International (2015) Global Packaging Landscape: Growth, Trends & Innovations [http://www.pmmi.org/files/ResearchandTrends/ Industry/ Global-Packaging-Trends-ES.pdf](http://www.pmmi.org/files/ResearchandTrends/Industry/Global-Packaging-Trends-ES.pdf)

S. Newman et al. 2015. Marine Anthropogenic Litter. Chapter 14 The Economics of Marine Litter  
DOI 10.1007/978-3-319-16510-3\_14

Statista, 2016. Bottled water consumption worldwide from 2007 to 2017 (in billion liters). <https://www.statista.com/statistics/387255/global-bottled-water-consumption/>

UNEP and GRID-Arendal, 2016. Marine Litter Vital Graphics. United Nations Environment Programme and GRID-Arendal. Nairobi and Arendal. [www.unep.org](http://www.unep.org), [www.grida.no](http://www.grida.no)

The North Sea Foundation / Stichting De Noordzee is an environmental non-governmental organisation (NGO) advocating the protection and sustainable use of the North Sea marine ecosystem. The goal is a clean, healthy sea and a well-functioning ecosystem. Its activities are focused on clean seas and beaches, clean shipping, sustainable fisheries, eco-friendly sustainable energy and marine protected areas.

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# Annexes

## Annex 1

### OSPAR data

Table 1. Number of plastic caps found per 100m beach on OSPAR Beach litter survey sites in the period 2004-2015

Country	Number of plastic caps collected	Average number of plastic caps per country	Number of surveys	Average number of surveys per year
Germany	1,234	8	164	14
Netherlands	3,563	19	184	15
Spain	15,188	79	192	16
Sweden	18,556	170	109	9
United Kingdom	39,543	64	614	52
Belgium	444	19	23	2
Denmark	3,219	140	23	2
France	7,693	73	105	9
Ireland	461	6	74	6
Portugal	1,040	14	73	6
<b>Total</b>	<b>90,941</b>	<b>58</b>	<b>1,561</b>	

Table 2. Number of plastic caps found on OSPAR Beach Litter survey sites in the period 2004-2015

Year	Average number of plastic caps per country	Number of plastic caps found	Number of surveys conducted
2004	42	3,870	93
2005	47	5,649	120
2006	67	7,791	116
2007	62	5,454	88
2008	67	6,478	97
2009	55	6,897	126
2010	79	10,135	129
2011	66	10,905	165
2012	57	7,295	127
2013	38	6,388	167
2014	46	7,705	166
2015	74	12,374	167

## Annex 2

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### Survey methodology

During the Boskalis Beach Cleanup Tour 2016 organised by Stichting De Noordzee, the participants were requested to collect plastic caps separately. This will allow The North Sea Foundation to gain greater insight into plastic cap pollution on the Dutch North Sea coast. The caps collected were counted, categorised and analysed in The North Sea Foundation's cap lab.

In total, 2,320 people took part in the Boskalis Beach Cleanup Tour 2016. The event was held from 1 to 14 August, spread over 28 stages running from Schiermonnikoog in the north and Cadzand in the south to Zandvoort in the centre of the country. At the start of every stage, the participants were asked to separate the plastic caps. Special paper bags were handed out for this purpose along with litter grabbers and bags for the general litter.

The entire North Sea coast has a length of 350 kilometres. The average length of the stages is between 5 and 11 kilometres. In total, more than 200 kilometres of North Sea coast is cleared. All participants start at the same time (around ten o'clock in the morning) and the stage ends at five o'clock in the afternoon. The area from the dune to the surf is cleaned. All visible litter on the beach surface is cleared. On average, 30-150 volunteers participate in a stage.

While participants were encouraged to separate the caps, doing so was each individual's choice. Some participants did not separate them so that some caps ended up in the bags with general litter. Furthermore, bad weather during some of the stages made it difficult to collect the plastic caps separately in the paper bags. This too will have resulted in some caps ending up in the general litter bags.

### Survey team

The survey team consisted of three volunteers who counted and categorised the plastic caps under the supervision of project leader Clean Sea of the North Sea Foundation. The analysis was done by the project leader and reviewed by the scientific board of The North Sea Foundation. This board consists of various scientists and researchers on marine biology, toxicology and marine governance.

### Methodology

The plastic caps were brought to The North Sea Foundation's cap lab in separate bags, most of which were labelled. They were then sorted according to stage number and put in separate plastic containers. Staff and volunteers then counted, categorised and analysed the caps in each container.

Using existing literature, nine categories were defined for registering the caps in an Excel database. The categories were:

1. Type
2. Colour
3. Brand
4. Usage
5. State of weathering
6. Location and density
7. Recycle code (only for the first 1,000 caps)
8. Producer (only for the first 1,000 caps)
9. Other features

## Type

A visual inspection of each cap was done to determine the original use of the cap. Internet research was done on any new type of caps collected to compare and determine the type. Much consultation took place among the volunteers and the project leader to categorise caps that were difficult to identify.

## Colour

The colour of each cap was registered in the database.

## Brand

When legible, the brand of each cap was registered in the database. Thereafter, internet searches and brand recognition determined if the brand was available in the Netherlands and/or in other countries.

## Usage

Based on the categorisation of the type of cap, a distinction was made in the cap's origins. Two categories were defined: 1) caps of products with industrial applications, and 2) caps of consumer products. If no clear user could be determined, the cap's usage was registered as unknown.

## State of weathering

Four categories were defined to indicate the extent of degradation. These were: 1) discoloured and/or highly damaged; 2) damaged; 3) slightly damaged; and 4) bright colour, very little damage.

Category	Duration of the cap in sea (rough estimate)
Discoloured and/or highly damaged	> 6 months
Damaged	3-6 months
Slightly damaged	1-3 months
Bright colour, very little damage	< 1 month or not in sea



Figure 1: Degradation of caps from highly damaged (far left) to very little damage (far right). Source: The North Sea Foundation, 2017

## Location and cap density

The caps were emptied from their paper bags into large bin bags after every stage. These were mostly labelled with the stage number. Unfortunately, not every bag was labelled so that we do not know the exact location of each cap. The distance of each stage and the number of caps found in that stage allowed us to calculate the density of each stage.

## Recycle code

The recycle code was noted for the first thousand caps. The reason for this was to determine the type of material used. Under European law, recycle codes on caps are not mandatory. Analysis of the first thousand caps clearly showed that most caps did not have codes and the time investment on our part was thus disproportionate.

## Producer

The names of the cap producers – if available and legible – was registered in the database. Analysis of the first thousand caps showed that most caps did not contain the producers' names and the time investment on our part was thus disproportionate.



### *Other features*

Any unusual features on the caps, such as illustrations or foreign languages, denoting an unknown brand, were registered.

### *Assumptions in this report*

- As the separation of plastic caps was voluntary, there was a chance that caps ended up in the general beach litter. In addition, some parts of the North Sea coast have not been cleaned. It can thus be safely assumed that the number of caps along the Dutch coast is actually higher.
- Those taking part in the Boskalis Beach Cleanup Tour largely associate plastic caps with soft drink bottles as these are recognisable to the general public. It can therefore be assumed that industrial caps, such as those of cleaning agents, ended up in the general beach litter. This means that it can be safely assumed that the actual number of caps along the Dutch coast is higher.

## *Annex 3*

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### *Additional questions*

- Do the same types of plastic caps wash up as in 2016? Do particular types of caps wash up on particular sections of beach?
- Is there a correlation between the annual production of half litre bottles in the Netherlands and the number of drink package caps found?
- Are there any differences between the different coloured caps that wash up? What colour caps are produced every year worldwide and is there a correlation with the colour of caps found in the Netherlands?
- Do the same brands wash up on beaches? Is there a clear trend in the international brands that wash up?
- Can comparisons be made to the monitoring data collected for litter in rivers and/or river banks?
- Is there a correlation between certain economic activities that take place in the North Sea and the sources of caps?
  - Do more caps with industrial applications wash up in areas where fishery and/or off-shore activities take place?
- Is the percentage of brightly coloured very little damaged caps comparable to those of 2016? And does this say anything about the number of caps left behind by beachgoers?
- Can an estimate be made of the number of caps that wash up from the sea in relation to the degree of degradation?
- Do more caps wash up in the part of the Netherlands north of the rivers? (the more densely populated part of the country)
- Would freshwater DNA methodology show which caps come from rivers?
  - Are there differences in the growth on caps found in the south of the Netherlands and those found in the Wadden Sea islands?
- Do annual weather conditions play a role? For example, do the number of storms in the North Sea play a role?
- Is there a correlation between the coastal municipalities' cleaning activities and the quantity of caps found?

## Annex 4

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### Policy framework (Source: Noordzeeloket, 2017)

The European Framework Strategy for Marine Strategy (KRM) obliges Member States to achieve or maintain a good environmental state by 2020 by their marine waters. In the Netherlands, this directive is being implemented in the Marine Strategy for the Dutch part of the North Sea 2012-2020.

The Dutch government has stated in the Marine Strategy that its target for 2020 is to reduce litter on the coast (beach waste) and the impact on marine organisms (“plastic particles in the stomachs of Northern Fulmar”). The following Good Environmental Status objective is formulated in the Marine Strategy: “The characteristics and the amounts of marine litter should cause no damage to the coastal and marine environment”.

The following two environmental targets were set for 2020:

- Litter on the coast;
- There must be a downward

The government policy has been translated into practice by introducing additional measures to tackle the problem. In terms of litter reduction, the Netherlands is prioritising prevention. It is addressing the sources, creating communication and raising awareness, and is legislating for less harmful product chains. Examples of this last point include its Green Deals energy programme; levying product requirements; and legislating for improvements in waste policies. In addition, the Netherlands is taking mitigation measures, such as cleaning beaches and the Fishing for Litter initiative.

The directive sets out the initial environmental assessment for 2012, the good environmental status for 2020 and related environmental objectives and indicators (32 in total) for the Dutch part of the North Sea and ranked according to the eleven environmental descriptors of the Directive. The effectiveness of measures for descriptor 10 (marine litter) is monitored closely by monitoring the following indicators:

- Quantity, composition, distribution and sources of marine litter on the beach (indicator 31 in the KRM Monitoring Program)
- Quantities of plastics in the stomachs of northern storm birds (indicator 32).
- Quantity, composition, distribution and sources of marine litter on the sea floor.

### OSPAR

The OSPAR Commission (15 North Eastern Atlantic countries) and the EU are treaty parties and is engaged in the implementation of OSPAR's North East Atlantic Environment Strategy. The OSPAR committees work together to develop measures at regional level to achieve and maintain the good environmental state and environmental goals under the KRM. In 2014, OSPAR adopted the Regional Action Plan (RAP) Marine Litter. The plan describes actions and measures to achieve common goals in the OSPAR region for reducing marine litter.