



# REPORT

## Evaluation of OSPAR beaches



SALT Report no. 1043

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<b>Summary</b>	
<p>This report was written by SALT on behalf of the Norwegian Centre for Oil Spill Preparedness and Marine Environment (SOMM) and is an explanation of Norway's use of designated "OSPAR beaches" for monitoring beach litter. Needs related to beach litter monitoring are defined, based on information from written sources and interviews by representatives of management, scientists and the coordinators of the seven existing OSPAR beaches. Four different alternatives for expanding the number of Norwegian OSPAR beaches are investigated and answers given to three key questions from SOMM: How many OSPAR beaches should Norway have? What considerations and criteria should be used in selection of any new Norwegian OSPAR beaches? How often should beaches be monitored?</p>	
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# PREFACE AND ACKNOWLEDGEMENT

For many years, the OSPAR member states have worked determined with common measures to reduce marine litter. It became clear early on that one needs knowledge of the scale of this major environmental problem in order to begin resolving it. Of the various areas where marine litter is found, beaches are the easiest to access and operate in. A method for monitoring beach litter therefore became one of OSPAR's first indicators for marine litter.

The Norwegian authorities chose OSPAR's method as an indicator for marine litter in 2011. After almost eight years of experience with the protocol, the time has come for an evaluation of what has been successful and how Norway can best utilize this method in the coming years.

On behalf of SALT, we are grateful for this engaging assignment.

Trondheim, December 13, 2019



**Erlend Standal**

Project Manager, SALT

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## Summary

This report is written by SALT on behalf of the Norwegian Centre for Oil Spill Preparedness and Marine Environment (SOMM) and is an evaluation of Norway's use of designated «OSPAR beaches» for beach litter monitoring.

### *The OSPAR method*

OSPAR is an abbreviation of the Oslo-Paris Convention for protection of the marine environment of the North-East Atlantic. OSPAR implement necessary measures to protect and conserve ecosystems and natural diversity in the North-East Atlantic, including measures to combat marine pollution.

One such measure introduced by OSPAR is a beach litter monitoring method where all visible litter items on fixed 100-meter stretches of beach are removed and classified into 112 different categories.

Norway uses this method to monitor seven active beach locations. This is a small number compared to several other OSPAR member states, particularly given Norway's extensive coastline. Locations are also monitored less frequently, only one or two times a year (average of 1.3 times), in comparison to the four annual observations recommended by the OSPAR protocol.

### *The needs of Norway*

As part of the evaluation, SALT has interviewed representatives from management, scientists and coordinators of the existing beaches, and has studied other available information, to identify the needs of Norway for beach litter monitoring.

The ability to report to OSPAR and determine sources of litter were the most obvious and common needs identified. Other needs include: help identifying preventive measures and evaluating their effects (e.g. Norwegian marine management plans and the water management regulations), streamlining marine litter clean-up campaigns, documenting regional differences and providing data for research on marine litter. We have evaluated how well the current coverage, and a possible future increase in the number of OSPAR beaches, meet these needs.

### *Four alternative models for expansion*

SALT has evaluated four different alternatives for expanding the OSPAR beaches in Norway:

#### *Alternative 1: No expansion (Status quo)*

Norway continues with its seven active OSPAR beaches.

#### *Alternative 2: Moderate expansion*

The existing beaches are expanded by a further 10 beaches (to a total of 17). This provides better geographical coverage along the Norwegian coast and enables a rough comparison of geographical differences.

#### *Alternative 3: Large expansion*

The existing beaches are expanded by a further 30 beaches (to a total of 37), which are recommended to be placed in about 10 «clusters», each with 3-4 locations. Such an organization and the larger number of locations give a higher resolution of the dataset. The statistical analyzes will be strengthened and will make it possible to measure trends in amounts and composition of litter with greater certainty.

#### *Alternative 4: Establishment of a complete monitoring program*

SALT has proposed a monitoring program which would provide information on beach litter quantities, composition and sources, as well as measure for prevention and cleanup.

Of these, Alternative 4 provides the best possible coverage of the identified needs. Alternative 3 is a good starting point for improved knowledge of beach litter through the use of the OSPAR method alone.

### **Answers to three key questions**

#### **1. How many OSPAR beaches should Norway have?**

The answer to this question depends on Norway's ambitions as the OSPAR member state with the longest coastline. To cover Norway's part of Region I - Arctic Waters, the largest region in the OSPAR Maritime Area, the number of monitoring beaches should be raised to the level described in Alternative 3.

From a national point of view, Alternative 4 best meets identified needs for beach litter monitoring, while requiring fewer OSPAR beach litter locations than Alternative 3.

#### **2. What considerations and criteria should be used in selection of new Norwegian OSPAR beach litter locations?**

The recommended criteria by OSPAR for selection of beach litter locations should be followed. In addition, one might consider adding the criterion that the locations should have an approximate straight-line shape. Exceptions can be made for locations which is to be used for monitoring beach litter from a specific local source.

An increase of locations to the level described in Alternative 3 provides the opportunity to organize beaches in clusters, each with 3-4 closely located locations. This will allow for a rough comparison of quantities and composition of beach litter between the different regions the clusters are placed into.

If Alternative 4 is chosen, the selection of OSPAR beach litter locations should be optimized for the monitoring program as a whole.

#### **3. How often should beaches be registered?**

For new locations, one should, if possible, comply with the OSPAR guidelines, which recommend four annual registrations per location. However, challenges related to snow and ice conditions during the winter season can limit annual registrations to two or three times in some regions.

A change in the registration frequency for existing locations will break the established time series. It is recommended to maintain existing frequency for these, as long as this still allows the data to be used either in OSPAR or nationally.

## Summary in Norwegian

Denne rapporten er skrevet av SALT på oppdrag fra Senter for oljevern og marint miljø (SOMM), og er en utredning av Norges bruk av såkalte «OSPAR-strender» til overvåking av strandsøppel.

### *OSPAR-metoden*

OSPAR er en forkortelse for Oslo-Paris-konvensjonen for bevaring av det marine miljø i Nordøst-Atlanteren. OSPAR skal gjennomføre nødvendige tiltak for å beskytte og bevare økosystemene og naturmangfoldet i Nordøst-Atlanteren, herunder tiltak mot marin forurensning.

Et av tiltakene som er innført er å overvåke strandsøppel etter en metode som er utviklet i OSPAR. Metoden går ut på at man teller og fjerner alt avfall på den samme 100 meter lange strekningen av en strand, og registrerer alt avfallet inndelt i 112 ulike kategorier.

Norge bruker denne metoden til å overvåke syv aktive lokaliteter. Dette er et lite antall lokaliteter sammenlignet med flere andre medlemsland i OSPAR, noe som kommer enda tydeligere frem dersom man tar i betraktning at Norge har en svært lang kystlinje. OSPAR-metoden gir flere anbefalte kriterier for utvalg av lokaliteter til overvåkingen. Det er anbefalt at hver strand registreres fire ganger i året. Norge registrerer sine strender 1-2 ganger (i gjennomsnitt 1,29 ganger) per år.

### *Norges behov*

Som en del av utredningen har SALT intervjuet representanter fra forvaltning, forskning og koordinatorene for de eksisterende strendene, samt studert annen tilgjengelig informasjon, for å kartlegge hva som er Norges behov for overvåking av strandsøppel.

Et åpenbart behov er å kunne rapportere til OSPAR. Et annet behov som nevnes av de fleste er å kunne identifisere kilder til avfallet. Andre behov er å identifisere forebyggende tiltak, evaluere effekter av tiltak og å bruke overvåkingen som en indikator for helhetlige havforvaltningsplaner og i arbeidet med vannforskriften, samt for å effektivisere rydding av marint avfall, dokumentere regionale forskjeller og å gi data til forskning på marin forurensning. Det er foretatt en vurdering av hvordan dagens dekning og en eventuell øking av antall OSPAR-strender dekker disse behovene.

### *Fire alternative modeller for utvidelse*

I utredningen har SALT undersøkt fire ulike alternativer for utvidelse av Norges OSPAR-strender:

#### *Alternativ 1: Ingen utvidelse (null-alternativet)*

Norge fortsetter med sine syv aktive OSPAR-strender.

#### *Alternativ 2: Moderat utvidelse*

De eksisterende strendene utvides med ytterligere 10 strender (til totalt 17). Dette gir en bedre geografisk dekning langs norgeskysten, og muliggjør en grov sammenligning av geografiske forskjeller.

#### *Alternativ 3: Stor utvidelse*

De eksisterende strendene utvides med ytterligere 30 strender (til totalt 37), som anbefales plassert i omlag 10 klynger, hver med 3-4 lokaliteter. En slik plassering og det større antallet lokaliteter gir en betydelig høyere oppløsning på datasettet. De statistiske analysene vil styrkes og man vil kunne måle endring over tid med større sikkerhet enn ved færre lokaliteter.

#### *Alternativ 4: Etablering av et komplett overvåkningsprogram*

SALT har foreslått et overvåkningsprogram, bestående av flere komponenter, som tilsammen gir informasjon om: Mengder (total mengde strandsøppel og strender i årlig tilførsel), sammensetning, kilder, tiltaksovervåking (iverksatte og lokale tiltak), samt beskrevet nye metoder som kan tilføyes i de nærmeste årene.

Av disse fire alternativene er det alternativ 4 som gir en best mulig dekning av de kartlagte behovene. Alternativ 3 er et godt utgangspunkt for å få bedre kunnskap om strandsøppel ved bruk av OSPAR-metoden alene.

### **Svar på tre sentrale spørsmål**

#### **1. Hvor mange OSPAR-strender bør Norge ha?**

Svaret på dette spørsmålet avhenger av Norges ambisjoner. Region I – Arctic Waters er den største regionen i OSPAR-området, og det er få land som ligger i denne regionen. Norge har den lengste kystlinjen av alle OSPAR-landene. Hensynet til å dekke Norsk del av Region I tilsier at antall lokaliteter bør heves til nivået som beskrives i alternativ 3.

Alternativ 4 er det alternativet som best dekker nasjonale behov for overvåking av strandsøppel. Behovet for antall OSPAR-strender sett fra et rent nasjonalt ståsted er lavere for dette alternativet sammenlignet med alternativ 3.

#### **2. Hvilke hensyn og kriterier skal legges til grunn for utvelgelse av eventuelle nye norske OSPAR-strender?**

OSPARs anbefalte kriterier for valg av lokaliteter bør følges. I tillegg kan man vurdere å innføre som kriterium at strendene som velges bør ha en tilnærmet rettlinjet form. Unntak kan gjøres for strender som skal benyttes til overvåking av strandsøppel fra en konkret lokal kilde.

En økning av strender på nivå med alternativ 3 gir mulighet for å etablere strender i klynger, med 3-4 nærliggende lokaliteter. Dette vil muliggjøre en grov sammenligning av mengder og sammensetning av strandsøppel mellom de ulike regionene klynger plasseres i.

Dersom alternativ 4 velges, bør man velge en plassering av OSPAR-strendene som er optimal for overvåkingsprogrammet som helhet.

#### **3. Hvor ofte bør strendene registreres?**

For nye lokaliteter bør man om mulig forsøke å overholde OSPARs retningslinjer, som tilsier fire registreringer i året per strand. Spesielle utfordringer knyttet til snø og is vinterstid kan imidlertid føre til at man må redusere til 3 eller 2 ganger per år.

En endring av registreringsfrekvens for eksisterende lokaliteter vil føre til at de etablerte tidsseriene brytes. Det anbefales å beholde eksisterende frekvens for disse, så fremt dette fortsatt gjør det mulig å bruke dataene enten i OSPAR eller nasjonalt.

# 1. HISTORY AND BACKGROUND

## 1.1 Background for the assignment

Marine litter is one of the greatest and most serious environmental problems of our time. Knowledge of marine litter has been present for many decades, but it is only in the last decade that we have become particularly aware of what this problem entails. The administration, media and research communities have all become engaged, and a large number of voluntary organizations working on marine litter issues emerged.

The Norwegian Environment Agency is responsible for following up work on marine litter in the Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), including coordination of monitoring of beach litter on Norway's seven active "OSPAR beaches" - i.e. beaches that are registered using a method developed in OSPAR. Signals have been given that the coordination responsibility for monitoring will be transferred to the Norwegian Centre for Oil Spill Preparedness and Marine Environment (SOMM). The Norwegian Environment Agency will continue to follow up the remaining work on marine litter in OSPAR.

The Ministry of Climate and Environment (KLD) commissioned SOMM to study Norway's OSPAR beaches, and whether Norway should expand the network of beaches monitored by this method. Salt Lofoten AS (SALT) has on behalf of SOMM accepted the requested evaluation work, and the findings are shown in this report.

## 1.2 What is OSPAR?

In the following, we will describe the OSPAR Convention and Norway's relationship with OSPAR.

### *The Oslo-Paris Convention*

OSPAR is an abbreviation of the Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic. The Convention was signed in 1992 and combines the Oslo Convention of 1972 on dumping waste into sea, and the Paris Convention of 1974 on land-based sources of marine pollution. The Convention came into force in 1998. Norway, 14 other European countries and the EU, are members (signature states) of the Convention.

OSPAR will implement the necessary measures to protect and conserve the ecosystems and natural diversity of the North-East Atlantic. If necessary, OSPAR should work to ensure that marine areas that are significantly affected, are being reversed to their original condition. The Agreement also facilitates collaboration on the development of programs to control human activity which is affecting nature in the area.

The Agreement consists of a main section of general provisions, in addition to five attachments that regulate pollution from land-based sources, dumping and combustion at sea, pollution from offshore sources, monitoring and biodiversity.

The OSPAR Commission is the Convention's supreme and conclusive organ, whereas the work is divided into five committees, each responsible for its own topics. The work on marine litter in OSPAR is organized by the "*Environmental Impact of Human Activities Committee*" (EIHA). Much of the practical work takes place in a working group called the "*Intersessional Correspondence Group on Marine Litter*" (ICG-ML), which is organized under this committee.

Four other groups support the work of the Commission: The Coordination Group (CoG), delegation leaders from the various member states (HoD), a group of lawyers and linguists (JL) and the Committee of chairmen and Vice-Chairmen, who leads the work of the other five committees (CVC).

The work of the Convention is also assisted by the secretariat, which has its office in London.

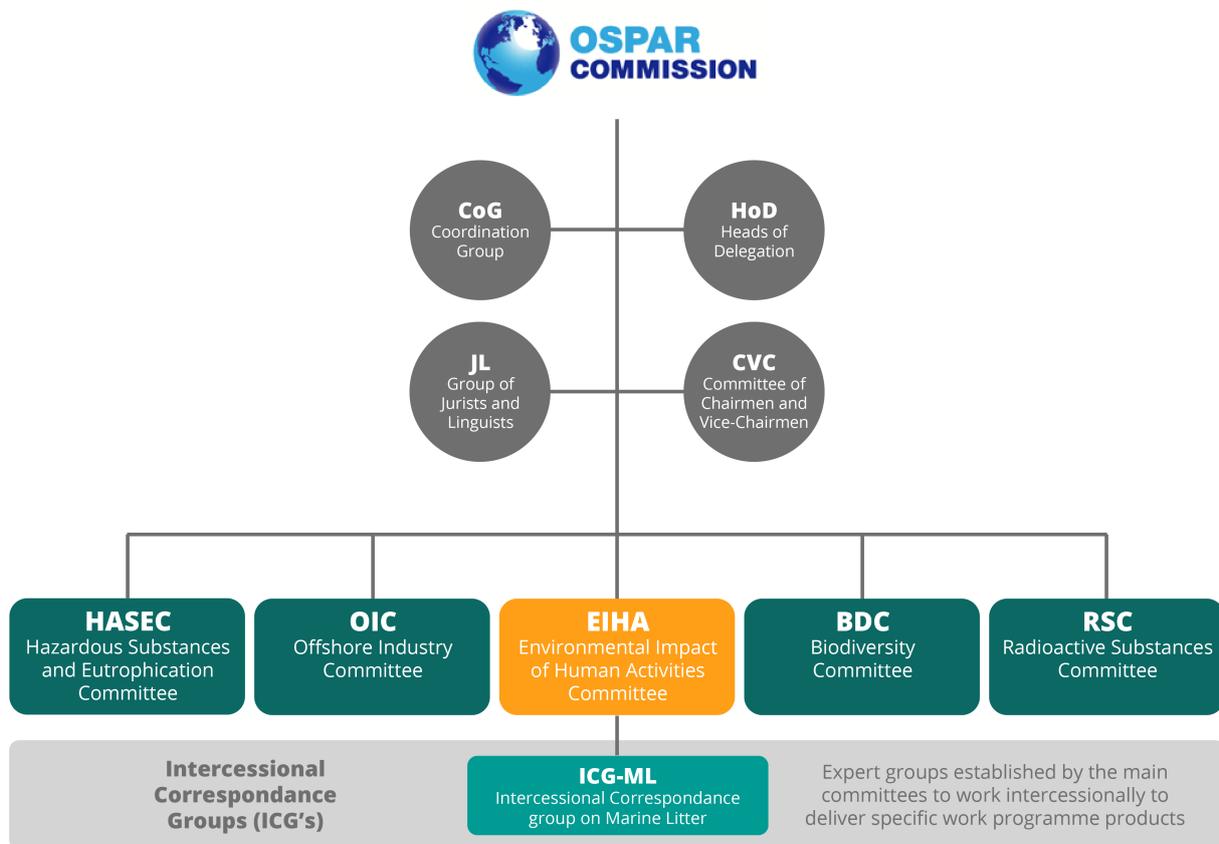


Figure 1. Organization chart for OSPAR, with particularly focus on the work on marine litter. (Illustration: SALT)

### Organization of the work on OSPAR in Norway

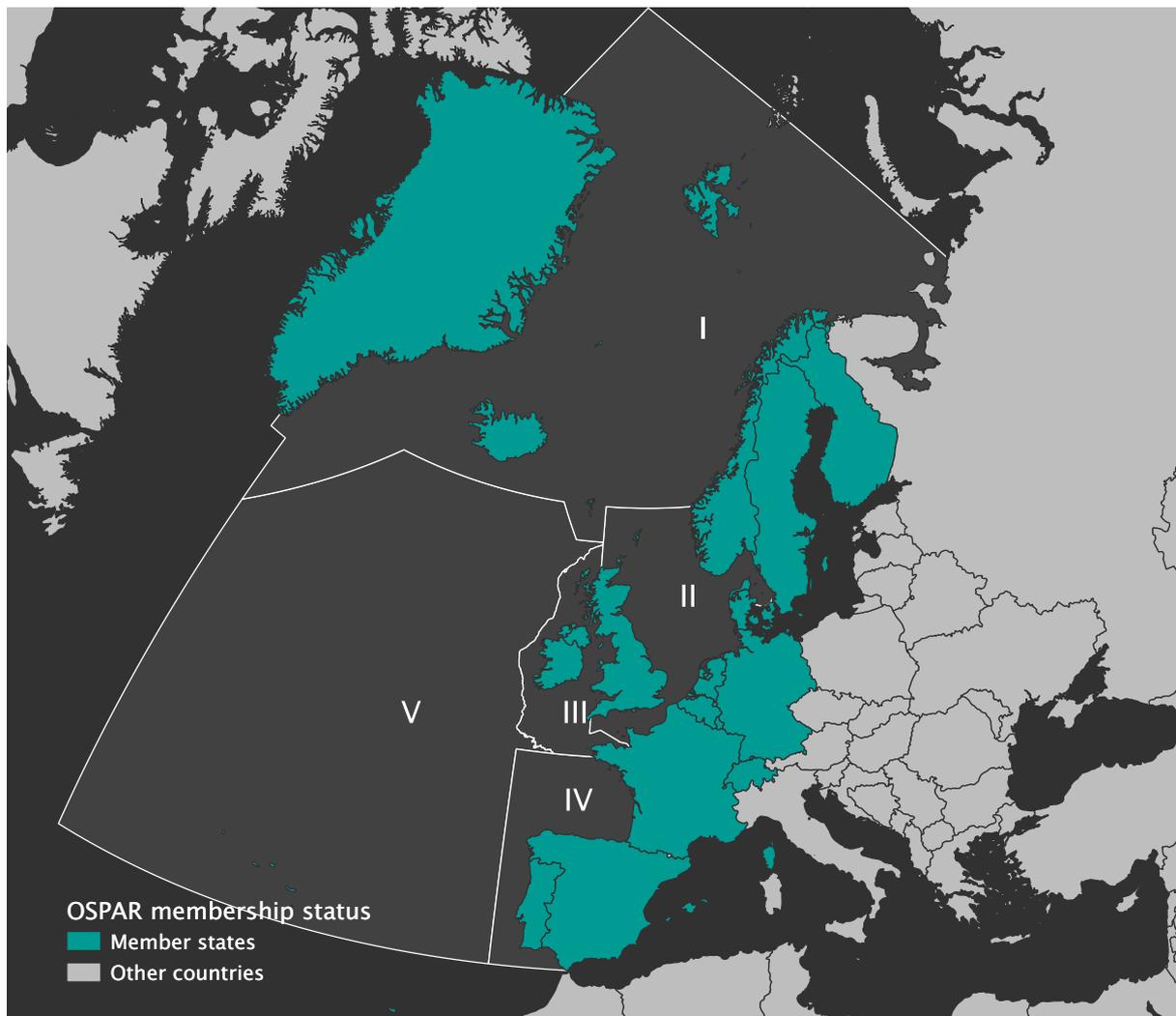
The Ministry of Climate and Environment (KLD) is the managing authority for OSPAR in Norway and is responsible for follow-up of the OSPAR Convention.

The Norwegian Environment Agency has a leading role for the work of the committees: The Environmental Impact of Human Activities Committee (**EIHA**), The Biodiversity Committee (**BDC**), the Hazardous Substances and Eutrophication Committee (**HASEC**) and the Offshore Industry Committee (**OIC**).

The Norwegian Radiation and Nuclear Safety Authority is responsible for following up the work on radioactive substances (**RSC**).

### The OSPAR area

OSPAR is a so-called independent “Regional Seas Convention”, covering the North-East Atlantic region. The OSPAR Maritime Area extends from Spain and Portugal in the South, to the North Pole in the North – from Greenland in the West to mainland Europe in the East (Figure 2). Some of the signature states’ (Finland, Switzerland and Luxemburg) coastlines are not directly connected to the OSPAR area but are located by rivers that ends into the OSPAR area. Russia lies within parts of the OSPAR area, but is not a signature state, and because of this not obliged by the convention and measures enacted.



**Figure 2. The OSPAR Maritime Area. Countries with green color are member states. OSPAR's regions are marked with Roman numerals. (Illustration: SALT)**

### ***OSPAR's three levels of resolutions***

OSPAR may adopt various measures to protect the environment within its area of responsibility. These measures are divided into three different levels with decreasing levels of commitment for the parties, respectively: **“Decisions”**, **“Recommendations”** and **“Agreements”** (other agreements, guidelines, etc.). Only resolutions at the “Decision” level are legally obliged to follow. Member States are also obliged by the Convention to apply the “precautionary” principle in the implementation of the obligations.

The OSPAR method for registration of beach litter is adopted as an Agreement (the latest version is OSPAR Agreement 2017-05) – i.e. at the lowest of OSPAR's three levels. An earlier resolution (Agreement 2010-02) is a more concrete description of how the method is to be practiced, with all forms attached and an image guide for identifying items within the various OSPAR IDs. At the same time, OSPAR's regional action plan against marine litter (“Marine Litter Regional Action Plan”, adopted as OSPAR Agreement 2014-1) provides recommendations on beach litter monitoring.

For the Member States that have implemented the Marine Strategy Directive, the registration of beach litter according to the OSPAR method is included as an indicator of *«Trends in the amount of litter washed ashore and / or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source»* (MSFD indicator 10.1.1).

### ***Organizing of mapping and monitoring in OSPAR – aim of reducing marine litter***

In OSPAR, mapping and monitoring is coordinated through the “*Joint Assessment and Monitoring Program*” (JAMP) and the “*Coordinated Environmental Monitoring Program*” (CEMP). Strategic planning of higher-level mapping and monitoring is described in JAMP, including the requirements for thematic and comprehensive evaluations, such as the Quality Status Report and Intermediate Assessment 2017 (see below). The implementation of monitoring, data collection and assessments, is coordinated through CEMP across the Member States. The purpose of CEMP is to facilitate the development of common and comprehensive evaluations, which address the issues highlighted in JAMP, easily. CEMP specifies the information needs more precisely and describes common approaches for implementation of data collection, monitoring and data analysis

For each ten-year period, OSPAR develops a strategy for its work and what goals it sets for the period. This strategy is called the “*North East Atlantic Environmental Strategy*” (NEAES). OSPAR has not set specific goals for reducing beach litter to a given limit, but at the Bergen Ministerial meeting in 2010, OSPAR agreed on the following objectives in NEAES: «*OSPAR agreed to substantially reduce marine litter in the OSPAR maritime area to levels where properties and quantities of marine litter do not cause harm to the coastal and marine environment*». In this there is an obligation.

Every few years, OSPAR publishes a “*Quality Status Report*” (QSR), which summarizes the activity within mapping and monitoring since the previous QSR and contributes a status of how different areas are compared to adopted indicators and goals set for these in NEAES. Beach litter is included as a part of this evaluation. The last QSR was published in 2010. Between each QSR a somewhat less comprehensive “*Intermediate Assessment*” (IA) can be released, which, like the QSR, provides background information and updated status of the environmental condition in the OSPAR area since the previous QSR. The last IA was published in 2017<sup>1</sup>. The next QSR is planned to be published in 2023. OSPAR 2019 (the 2019 Commission Meeting) adopted a separate “*QSR 2023 Guidance Document*” (OSPAR Agreement 2019-02<sup>2</sup>), which will guide work towards a completed QSR in 2023. OSPAR's “*Quality Objective*” (sub-goal of QSR) for beach litter is that the amount of marine litter that is registered through the OSPAR beach litter monitoring on 100-meters beaches, should decrease.

The so-called OSPAR ministerial meetings are organized about every ten years. These are commission meetings where environmental protection ministers (or delegates representing them) from all parties also attend the final days of the meeting. The previous ministerial meeting was held in Bergen in 2010. The next ministerial meeting is planned to be held in Lisbon in July 2020.

## **1.3 Description of the OSPAR method for beach litter monitoring**

When using the OSPAR method, selection of locations to be registered in each country is the first thing that needs to be done. The same 100-meter-long section of beach should be registered every time. Previously, a 1 kilometer stretch of beach was also registered following a rougher protocol, but this part of the registration was made voluntary from 2017. For Norway, this part of the registration ended then. Within a 100-meter-long section of the beach, items are registered from the water's edge and up to where the beach ends, defined as where physical formations, such as rocks or sand dunes, mark the transition to the area within the beach. It is important to use the same boundary each time the beach is registered.

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<sup>1</sup> <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/>

<sup>2</sup> <https://www.ospar.org/documents?v=40951>

OSPAR Agreement 2010-02 «*Guidelines for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area*» has recommendations on what type of beach is best suited for registration. Preferably, the beaches should:

- be composed of sand or gravel and exposed to the open sea;
- be accessible to surveyors all year round;
- be accessible for ease of marine litter removal;
- be a minimum length of 100 metres and if possible over 1 km in length;
- be free of “buildings” all year round;
- Ideally not be subject to any other litter collection activities.

The guidelines recommend to follow these principles as closely as possible but allow coordinators to use expert knowledge of coastal and marine litter in each country in the final selection of beaches to the network.

The beach is assigned an OSPAR-ID, which for Norway has the format NO XXX (where X is a serial number). Some background information about the beach itself is collected, including GPS coordinates, beach width, prevailing current and wind direction, as well as proximity to buildings, rivers, ports, etc. This is registered in the “*OSPAR Marine Litter Beach Questionnaire*” form.

Before registration of the beach can start for the first time, it must be cleared completely for marine litter. This is done to remove all litter that has accumulated over the years, so that only beach litter that accumulates between each period is registered. In other words, the beach is “reset”. This must also be done if for some reason a beach is not registered at the interval set for the beach. The registration itself can only start at the next scheduled interval.

The OSPAR method requires a beach to be registered four times a year, for defined periods of time (Table 1). In Norway, this deviates for the seven existing beaches, which are registered either once or twice a year (see the section “*Deviations from the OSPAR method in Norway*” below).

**Table 1. Periods of registration, according to the OSPAR method. The registration itself should be done over a short period of time, and preferably at approximately the same time each year.**

Period of Registration	Time Span
<i>Winter</i>	From mid-December to mid-January
<i>Spring</i>	April
<i>Summer</i>	From mid-June to mid-July
<i>Autumn</i>	From mid-September to mid-October

At each registration, all visible litter is picked up. Furthermore, one registers the number of each item in the “*OSPAR Marine Litter Monitoring Survey Form*” for 100 meters of beach. There are 112 different types of items in the form, each with its own OSPAR ID. Items that do not have their own ID are registered and specified under the “*other ...*” field in the form, which exists for each main category / material type.

All beach litter is removed from the beach as part of the registration, so that each item is counted only in a single registration. Larger items of metal or wood may be leaved behind, but then one must ensure that these are not counted again on subsequent registrations.

In Norway, the practical implementation of the registration is somewhat different from beach to beach.

- On some beaches two people walk together along the beach. One picks items from the beach and puts them in a bag, while the other notes each item in the form.
- On other beaches, all the litter is picked up in bags and everything is then taken to a suitable place for sorting and subsequent registration.

According to the OSPAR guidelines, items should be registered at the same time as they are picked up from the beach. However, his practice is deviated for practical reasons for some Norwegian beaches (see the section "*Deviations from the OSPAR method in Norway*" below). Nonetheless, it can be advantageous to use the same procedure from time to time within the same beach.

After a beach is registered in the form, the number of each type of item should also be entered into OSPAR's database<sup>3</sup> for beach litter data on the Internet, to ensure that beach data becomes available for use in OSPAR. This is usually done by sending the form to a national coordinator, who enters the data into the database. This provides an extra element with quality assurance. Some of those responsible for registering the individual beaches in Norway have access to enter data into the database themselves. The database also has built-in tools for quality assurance of data entered. Among other things, upper limits have been set for the number of items that can be entered for each type of litter that is entered. This might provide security against misclassification.

### ***Deviations from the OSPAR method in Norway***

Ytre Hvaler beach is the Norwegian OSPAR beach which differs most from the Dutch "ideal beaches" for which the OSPAR method was originally developed. On paper, it meets the recommended criteria stated in guidelines for selection of beaches with the exception of the number of annual registrations. But, as it is "strategically" located where currents from the Oslo Fjord, Glomma and Skagerrak / Kattegat meet, so much marine litter accumulates here that it is not considered good use of resources to pick up and count all the items individually on the entire beach. Instead, since 2014, some of the litter has been registered in transects and scaled up based on this. This is accomplished by picking up all the litter from the entire beach. Yet, undefinable plastic pieces under 2.5 centimeters and very short ropes are only counted in transects of 5 x 30 meters. The number is scaled up to the entire length of the beach based on this. From the wrack zone (which is 15 meters long) all the big pieces are picked up and registered. Everything else (tiny plastic bits, small pieces of rope, biofilm carriers from wastewater treatment plants, etc.) is only picked in a 3 meter (20%) long transect and scaled up to the wrack zone as a whole from this.

Another deviation from the method is that the Norwegian beaches are only registered once or twice a year, and not four as specified in the OSPAR guidelines.

The OSPAR guidelines also state that the items must be registered when they are picked up from the beach, and not collected and registered afterwards. The reason is that fragile items, such as plastic items that have been exposed to sunlight for a long time, can be cracked into several pieces when collected in a bag. However, this is practiced somewhat differently on the Norwegian beaches. On beaches where they collect and register afterwards, this is done because large quantities of litter are being registered, which is difficult to carry out in the field.

### ***Strengths of the OSPAR method***

- + A major advantage of the OSPAR method is that it is used in many European countries. This allows a comparison of different types of marine litter between all the beaches that are reported in OSPAR's database.
  - This requires that everyone practices the method equally. Here, there are some differences also between the Norwegian beaches - for instance to what degree the smallest fragments are picked and registered.

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<sup>3</sup> <https://www.mcsuk.org/ospar/>

- + The method is well suited to assess the effect of targeted measures on marine litter, if certain conditions are met (see section below: *“What can we use the OSPAR method for – and not?”*).
- + The large number of different types of items (OSPAR IDs) used in the method allow for a relatively detailed picture of the marine litter present at a beach.
- + Thorough documentation of the mapped area allows analysis of the density of litter. This is generally missing from voluntary beach cleaning data.
- + Repeated registrations from the same location allow examinations of “new” litter without confusion from a mixture of new and old litter, which is often the case with data registered during voluntary beach cleaning actions. This increases the detection power when examining trends over time and to what extent the amounts of incoming litter increase or decrease.
- + Registering the exact same 100-meter stretch of beach each time provides a good basis for analyzing quantities and types of litter within the same beach over time. The method excludes variation in the area registered (which we see for data from the beach cleanup day of “Keep Norway Beautiful”) and reduce natural differences in the potential to recognize beach litter that would be obtained if the location varies between registrations.
  - At the same time, this introduces a possible bias<sup>4</sup> for geographical coverage, which means that the registrations can only be said to be representative of each beach and not the entire region in which they are located (see *“Limitations of the OSPAR method”* below).

### **Limitations of the OSPAR method**

- ÷ One of the biggest limitations of the OSPAR method is that the number of items is used as the only measurement parameter for quantity. This means, for example, that a small piece of rope in practice counts as much as a rope coil of 30 meters, or that a toothbrush weighing a few grams counts as much as an offshore buoy of more than a half a ton (Figure 3). This means that the importance of different sources / dominance of different items do not appear to be the same if one considers weight instead of number. This is particularly prominent for fishery-related litter, which tends to be large items (Falk-Andersson and Strietman, 2019). One disadvantage of using weight as a unit is that it can be affected by contamination with sediments, organic matter and water saturation (Schulz et al., 2013). There can also be major differences in the dominance of different items and types of materials if one calculates in volume. For example, Styrofoam can have a large volume and very low weight, while the number is highly dependent on how disintegrated it is (Hong et al., 2014). Weight will also be less sensitive to different degrees of accuracy between different observers. The total weight of the litter which is cleaned will change relatively little compared to how accurately the smallest fragments of litter are cleaned and registered. The total number, on the other hand, can change drastically, and therefore also cause the percentage of different items / material types to vary greatly with cleaning intensity. Therefore, it is reasonable to conclude that one should measure quantity in more than one unit to get as clear as possible picture of littering (Falk-Andersson and Strietman, 2019; Hong et al., 2014), and also to facilitate standardization between beaches and observers.
- ÷ The choice of beach is important for the amounts and type of litter that is registered. Only by moving several of the Norwegian beaches 100 meters aside, one will be able to achieve a big difference in the number and type of items that are registered. This is probably particularly prominent in Norway, with a much more diverse coastline and varied substrate than the one found on, for example, Dutch and Belgian sandy beaches, which have a more straight coastline and uniform substrate. A heterogeneous coastline leads to large and very local inequalities in ocean current conditions, which in turn leads to different garbage disposal (Schulz et al., 2013).

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<sup>4</sup> «Selection bias». In this context, the choice of beach is of importance for the amount and type of litter that is registered. See separate section on this under *“Limitations of the OSPAR method”*.

Even litter from the same source can be distributed differently between different nearby beaches as different flow characteristics can separate and disperse items (Schulz et al., 2013; Tudor et al., 2002). Therefore, a single beach cannot be considered representative of a region. This is evident from the fact that merging beaches for analysis leads to reduced test strength and that fewer significant trends are detected (Schulz et al., 2019, 2017).

- ÷ For moderate to heavily polluted beaches, the OSPAR method is a relatively labor-intensive way of registering beach litter. This is partly due to the large number of categories (OSPAR IDs) that the litter must be registered on.
- ÷ It takes a long time to build up sufficiently long time series for the method to provide the information you want. For the total amount of litter and density of the most common garbage items, four years of registrations are required four times a year to establish a baseline coefficient of variance <10% (Schulz et al., 2019). If one accepts a coefficient of variance of up to 20%, three years with four annual registrations may be enough to establish a baseline (Schulz et al., 2019). A time series of at least six years is required before data can be used to analyze trends where it is possible to detect minor changes (10% increase / decrease), provided that registrations are carried out four times a year (Schulz et al., 2019). Major changes in the total amount of litter of 30% can be detected with as few as 14 registrations (3.5 years), while 16-20 registrations (4-5 years) are needed to detect a 30% change in individual items (Schulz et al., 2019). These calculations are based on analyzes of data from OSPAR beaches further South in Europe. Norwegian OSPAR beaches were not included in the analysis. The location Saltö in Sweden (Region II) was the northernmost beach that was included in the analysis. There is reason to believe that this means that we need longer time series to detect change over time.
- ÷ Use of the method requires that the method is practiced consistently. This is most important within the same beach, but also between beaches, if, for example, one wishes to study any differences in the composition of the litter between the different beaches. Here there may be a need for training workers to ensure this. The OSPAR Agreement 2010-02 "*Guidelines for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area*" contains a multilingual photo guide to ensure the best possible comprehensive practice of registering different types of items within the same ID between the different OSPAR beaches.
- ÷ The boundary on how small items are to be registered is somewhat fluid. Initially, this is set to "all visible litter on the beach surface" (cf. the OSPAR Agreement 2017-05, section 2.4.7). However, this is practiced somewhat differently between beaches - at least in Norway, but probably also between different countries. For example, there is a difference between what can be regarded as visible litter if you walk upright on the beach and look for litter, or if you go more thoroughly to work and look with your eyes closer to the ground. This may also be influenced by differences in the characteristics of each beach. For example, it will be easier to find small items on a smooth sandy beach than on a cobblestone beach. It should be considered whether it is appropriate to establish a clearer distinction - either in the entire OSPAR area or only applicable to Norway.
- ÷ Beach litter is generally skew distributed by the fact that marine litter that floats and has good windfall is over-represented on beaches in relation to heavier litter (i.e. metal and glass), which often remain on the seabed near the source, and types of litter that readily dissolve or break down (i.e. paper and food waste). This limitation also applies to registration with the OSPAR method and must be taken into account when analyzing registered findings.

See also section below on "*What can we use the OSPAR method for - and not?*" for information on limitations of the method.



**Figure 3.** The OSPAR method uses only number as a measure of the amount of litter. This means that a small piece of rope (in the front of the picture to the left) in practice counts as much as a rope coil of many meters - or that a toothbrush of a few grams counts as much as an offshore buoy of more than half a ton. (Photo: SALT/Erlend Standal and Bo Eide)

## What are the abilities and limitations of using the OSPAR method?

### What are OSPAR data on beach litter suited for?

OSPAR beach litter data is useful for looking at variation in trends of numbers and types of items over time (sliding five-year averages are often used) within the same beach.

OSPAR beach litter data may be useful for monitoring the effect of certain measures on marine litter - for example, the possible introduction of ban on plastic shotgun shells (see Figure 9). Or perhaps more relevant nowadays: the introduction of ban on disposable plastic cutlery. However, for use of this purpose, it is important to ensure that the types of items are registered and that the actual locations is suitable to say something about the effect of the measure. If the measure targets a given local emission of these items, the location used for monitoring must be located downstream of the source. Natural fluctuations must also be taken into account. For instance, variations in predominant currents and wind directions from year to year can affect the amount registered. This is what one tries to counteract when looking at sliding five-year averages, in order to prevent years that deviate from the "normal" from having too high an impact on the analysis. It can also be demanding to monitor changes in emissions even from specific sources when using a single beach, as different flow characteristics in variable local flows and wind conditions can spread different litter from the same source differently along the coast (Tudor et al., 2002).

OSPAR beach litter data can, to a limited extent, be used to indicate sources of litter. To give a better overview of sources, the source of certain types of litter must be determined for each item to provide some degree of security, and this is not a part of the method. But for some of the items, source is

initially provided (example: ID 71 "Crab / lobster pot", ID 114 "Lobster and fish tags", ID 43 "Shotgun cartridges"). At the same time, many items, such as Styrofoam, can come from a variety of sources (Schulz et al., 2013).

Some of the types of litter that are registered are also more dangerous to wildlife than others (for example, ID 8 "Engine oil containers and drums <50 cm" or ID 116 "Nets and pieces of net> 50 cm"). Data from the OSPAR beaches can therefore be used to say something about the potential for wildlife damage in the various surrounding areas.

OSPAR beach litter data can be used to look at differences in the composition of types of litter between beaches, but it is important to recognize that beaches are not representative of larger areas and therefore do not correspond to a comparison of litter composition between areas or regions. Conclusions only apply to the specific beaches registered, due to large local variations that preclude extrapolation (Schulz et al., 2019, 2017).

### **What are OSPAR data on marine litter not suited for?**

OSPAR beach litter data is not suitable for quantifying the amount of marine litter in an area or region. The number of items alone is not a good measure for this (see Figure 3). Choosing the exact location is also such an important parameter for the quantities that can be expected to be found on a given 100-meter stretch. Therefore, the result on a selected beach can never be seen as a good indication of the amount within a larger area, even if one chooses to weigh the litter. Representative data from randomly selected locations in Aust-Agder, Lofoten, Vesterålen and Øst-Finnmark show that the amount of litter among sampled 100-meter stretches within an area has a coefficient of variance of 100-250%, both in weight and number (SALT, unpublished data). To reduce this effect, random selection of beaches registered could be used, but this in turn could cause problems in terms of suitability for using the OSPAR method on the randomly selected beach and breaking established time series. Another way to reduce the effect is to register a larger number of beaches. A preliminary study with randomly selected localities could say something about the amount of variation between beaches, and thus be used for a strength analysis that can give knowledge of the number of beaches needed in each country / region.

Similarly, for the same reason OSPAR beach litter data is not suitable for comparing the amount of litter between different regions.

## **Analytic tools**

### ***Litter Analyst***

OSPAR's first beach litter analytic tool was called "Litter Analyst"<sup>5</sup>, and was developed by statistics experts on behalf of Germany and the Netherlands to interpret the data collected in the beach litter database. The article "*OSPAR standard method and software for statistical analysis of beach litter data*"<sup>6</sup> and the report "*Evaluation and fine-tuning of a procedure for statistical analysis of beach litter data*"<sup>7</sup>, provides a thorough introduction to how a statistical analysis of OSPAR beach litter data should be conducted and potential sources of error in the dataset that one should be aware of.

### ***litteR***

In 2018, a new tool was developed for analyzing OSPAR's beach litter data, called litteR<sup>8</sup>. litteR is an open source tool developed to support OSPAR and EU researchers and policy makers to perform descriptive, trend, baseline, power and reduction analyzes of beach litter, and potentially other types of marine litter data. litteR produces a detailed HTML analysis report, where tables and figures can be

<sup>5</sup> <https://www.amo-nl.com/software/litter-analyst/> (Password is required for downloading the tool itself).

<sup>6</sup> <https://www.sciencedirect.com/science/article/pii/S0025326X17305246>

<sup>7</sup> <https://www.amo-nl.com/pdf/0Evaluation%20of%20procedure%20for%20beach%20litter%20data.pdf>

<sup>8</sup> Manual for litteR: <http://publicaties.minienm.nl/documenten/litter-user-manual-v3-0>

easily copied. litterR is developed as an "R package". R is a free software for statistical computing and graphics. It can be compiled and run on various UNIX platforms, Windows and MacOS.

## 1.4 History of using the OSPAR method in Norway

### *Increased attention against marine litter*

At the beginning of the 2000s, the attention towards marine litter was not as high as we see today, neither nationally nor internationally. However, attention increased internationally during this time. In the OSPAR context, especially the Netherlands and the UK were engaged and involved in fighting against marine litter. The Netherlands had taken the initiative to develop guidelines for monitoring of beach litter within the OSPAR area, based on their own work nationally with this. The work was continued through the ICG-ML.

Within OSPAR, there was an increasing focus on measures to reduce the extent of marine litter. At the ministerial meeting in Bergen in 2010, proposals were made to introduce a specific target for the percentage reduction of marine litter within the OSPAR area. There was no agreement to introduce such a percentage target during the meeting. This was mainly due to poor knowledge of the quantities of marine litter present on the beaches in the member states, and thus no basis for calculating a percentage reduction.

After the meeting, nonetheless, several countries, including Norway, took this as a strong incentive to begin monitoring the prevalence of beach litter within their own borders. It was the Norwegian Directorate for Nature Management (hereafter referred to as DN; which later on merged with the Norwegian Climate and Pollution Agency to form the Norwegian Environment Agency) who was responsible for following up marine litter in OSPAR from the Norwegian side. Therefore, it was also DN who took the responsibility for starting this monitoring.

### *Choice of method*

At this time, there were not many elaborated methods of registering beach litter. The most thorough method was the one developed by OSPAR. There was also a strong desire to be able to report data on beach litter in Norway to OSPAR. The OSPAR method was thus in reality the only real alternative.

The limitations of the method, which were explained earlier in the report, were known from the beginning. The method thus provided no basis for determining quantities of beach litter within a region but could say something about the variation from year to year within the same beach and about the composition of different types of waste. This could form the basis for an indicator of whether measures to reduce marine litter in Norway had the desired effect. However, in order to obtain a sufficient degree of accuracy, so that random variation from year to year should not affect the result to a great extent, measurements over several years was required as a basis. Therefore, it was urgent to start monitoring and establish a time series.

### *Selection of beaches*

As a result of little awareness of marine litter at this time, it was not easy to find funding to start the beach litter monitoring. It was therefore important to find solutions that did not involve high costs in order to get the monitoring started as quickly as possible. This could be achieved either by starting from initiatives that had already been initiated by others, or by utilizing that the Norwegian Environment Agency's operative field branch (hereafter SNO; at that time a department within DN) had natural inspections personnel spread throughout the country. The result was a mixture of these two alternatives.

During the period 2001 to 2011, beach waste was monitored at Svalbard through "Environmental monitoring at Svalbard and Jan Mayen" (MOSJ) at three locations: "Isflakbukta", "Breibogen" and

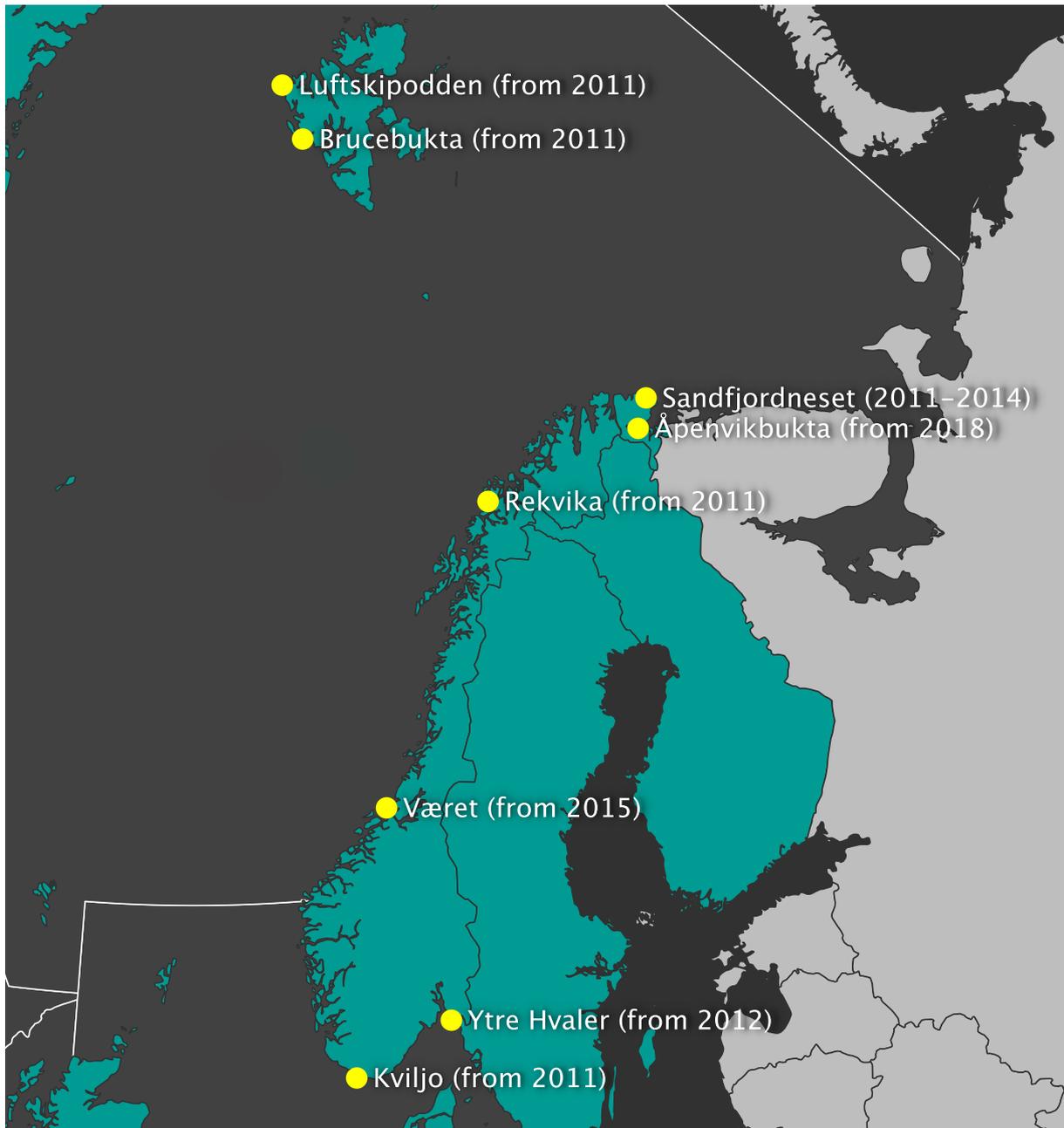
"Brucebukta". DN considered these as possible locations for mapping according to the OSPAR method. However, the experience of the MOSJ monitoring with the first two established locations was not the best, and the Norwegian Polar Institute wanted to phase out these two locations. The location of «**Brucebukta**» was retained, but the location was somewhat adjusted. In addition, the location «**Luftskipodden**» was established. From 2011, parallel registration was started both according to the OSPAR method and according to MOSJ's own protocol at these two locations.

In agreement with SNO, DN selected three additional beaches to be registered by the SNO crew. These were "**Været**" (Trøndelag), "**Kviljo**" (Vest-Agder) and "**Sandfjordneset**" (Finnmark). At "Været", a primary and secondary school, named Botngård, had monitored beach litter according to their own protocol on a four kilometer stretch of beach in the period from 1979 to 2010, with only a few "holes" in the time series. Yet, registration according to the OSPAR method did not start at this location until 2015. The last registration at the location Sandfjordneset was made in 2014. A new location "**Åpenvikbukta**" (Finnmark) has been established instead of this, and there has been registered marine litter at the new location in 2018 and 2019.

Environmental adviser Bo Eide in the municipality of Tromsø, had received modest financial support from DN the year before to clear the beach "**Rekvik**" with the help of a school class. The first step in using the OSPAR method is to clean the selected beach area completely (reset the beach). Since this was already done in Rekvik, registrations could be started as early as 2011. Tromsø municipality and Bo Eide were therefore asked if they could be willing to have responsibility for registration of this beach, and received continued modest support from DN.

The seventh beach became a reality after that "Oslofjorden friluftsråd" (Oslofjord Open Air Council) contacted DN and asked if they could establish an OSPAR beach in «**Ytre Hvaler**». This fits well with the location to the south-east towards the Swedish border, and in an area that receives inflow of water from both Glomma, the Oslo Fjord and the coastal flow from the Skagerrak. This location is a strong reason why this particular beach is the one that registers the highest number of litter items of all beaches reported to OSPAR.

Of all these beaches, Kviljo and the former location of Sandfjordneset are most similar to the beaches typically found further south in Europe, in terms of substrate and shape, and for which the OSPAR method was originally developed. In the selection of beaches, however, greater emphasis was placed on being representative of Norway than on matching perfectly with beaches described in the "OSPAR guidelines" - however based on a subjective assessment of representativeness. See Figure 4 for geographical location of the beaches mentioned.



**Figure 4. Map that shows the placement of the Norwegian OSPAR beaches.** Numbers in parentheses behind the location name indicate when registrations have been made (Illustration: SALT).

#### ***Coordination of Norwegian OSPAR beaches***

Efforts that have been made to coordinate the Norwegian OSPAR registrations have since the start of the monitoring in 2011 been governed by DN and later on from the Norwegian Environment Agency. The fieldwork that is done on each beach is distributed to different people, as described in the section on selection of beaches. These are responsible for the actual registration and cleaning of the beaches. Some of them also have access to register the findings directly in the OSPAR beach litter database, while others have sent the registration forms to the Norwegian Environment Agency for entry into the database.

It has been announced that the responsibility for coordination of the Norwegian OSPAR beaches will be transferred to the Center for Oil Conservation and Marine Environment (SOMM) in the near future.

### What are Norwegian OSPAR beach litter data used for so far?

There are not many studies that have used the Norwegian OSPAR data so far. Those we have knowledge about are presented in Table 2. In addition, data from Norwegian OSPAR beaches are continuously reported to OSPAR.

**Table 2. Known use of Norwegian OSPAR beach litter data.**

Application	Who	Year	Description
<i>Scientific paper: «Citizen science for better management: Lessons learned from three Norwegian beach litter data sets» (Falk-Andersson et. al. 2019)</i>	Jannike Falk-Andersson (SALT), Boris Woody Berkhout (University of Leicester) and Tenaw Gedefaw Abate (Norut)	2019	Comparison of Norwegian OSPAR beach litter data against data collected by Hold Norge Rent and Lofoten Avfallsselskap IKS.
<i>Poster with title «Litter on beaches and in fulmars in the Norwegian Arctic and North Sea»</i>	Lene Buhl-Mortensen (HI), Geir Wing Gabrielsen (Polarinstituttet), Tycho Anker-Nilssen (NINA) and Erlend Standal (SALT)	2018	The poster was presented at «the Sixth International Marine Debris Conference» (6IMDC) in San Diego, USA, March 12-16, 2018 and shows the occurrence of marine litter using data in plastics in the stomach of seahorses and data from the OSPAR beaches in Norway.
<i>Abstract to the OSM2020</i>	Johannes Röhrs et al.	(2020)	Abstract to the OSM2020 (Ocean Science Meeting 2020), San Diego, USA.
<i>General use</i>	NIVA, NORCE, with more		Uses information about OSPAR beaches to highlight the problem, without analyzing data in detail.
<i>OSPAR Intermediate Assessment 2017</i>	OSPAR	2017	Norwegian data were used in the analysis of the amount and composition of beach litter in the period 2014/2015.
<i>MOSJ</i>	Governor of Svalbard		The weight of marine litter registered at the two locations in Svalbard is also reported annually as a part of MOSJ (environmental monitoring at Svalbard and Jan Mayen) (MOSJ 2015).

One possible reason for the low interest in the dataset is that the method requires a relatively long time series to be used. It is only in recent years that there exist long enough time series that allows for looking at changes in registered beach litter over time.

Little use of the dataset may also be due to the challenges associated with the method, which is pointed out in the section "Limitations of the OSPAR method". The limitations that are believed to limit the interest in using the dataset to the greatest extent are that one uses only the number of items and not the weight to indicate the quantity, and that the method makes it difficult to use data from a beach

to say something about quantities of marine litter within a larger area / region (both are discussed in detail elsewhere in the report).

## 1.5 Do the Norwegian OSPAR beaches meet the OSPAR guidelines for selection?

As mentioned under the description of the OSPAR method for monitoring beach litter above, the OSPAR Agreement 2010-02 "*Guidelines for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area*" (OSPAR 2010) provides the following recommendations for the types of beach that are most suitable for registration:

1. Be composed of sand or gravel
2. Be exposed to the open sea;
3. Be accessible to surveyors all year round;
4. Be accessible for ease of marine litter removal;
5. Be a minimum length of 100 metres and if possible over 1 km in length;
6. Be free of "buildings" all year round;
7. Ideally not be subject to any other litter collection activities.

In Table 3 we have compared the seven existing beaches and the former location "Sandfjordneset" against these recommendations.

**Table 3. Assessment of the eight Norwegian OSPAR beaches against recommendations from the OSPAR guidelines** (carried out in consultation with the coordinators for the beaches).

Beach	Criteria number						
	1	2	3	4	5	6	7
<i>Været</i> (NO001)	- Consists of pebbles and salt marsh in the upper 1/3	- Lies exposed to Trondheimsleia	- The beach is located in a protected area with a traffic ban in Spring / early Summer	+	(+) The beach is more than 100 but shorter than 1000 meters	+	+
<i>Brucebukta</i> (NO002)	+	+	- Summer only	+	+	+	- May be influenced by tourists walking ashore at the Poolepynten
<i>Luftskipodden</i> (NO003)	- The beach consists of some rock	+	- Summer only	+	+	+	+
<i>Rekvika</i>	-	+	-	+	+	+	(+)

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(NO004)	Pebbles		Summer and Autumn only	Must be carried or transported by boat	The area registered is longer than 100 meters		Some other litter collection has occurred Signed with information
<i>Kviljo</i> (NO005)	+	+	+	+	+	+	(+) Some other litter collection seems likely
<i>Sandfjordneset</i> (NO006)	+	+	- Only available in the Summer	+	+	+	(+) Other litter collection has occurred
<i>Ytre Hvaler</i> (NO007)	+	+	- Snow and ice cover the beach during the Winter season (especially January to March)	+	+	+	(+) Some other litter collection has occurred the last year Signed with information
<i>Åpenvikbukta</i> (NO008)	(+) Consists of sand and pebbles	+	- Only available in the Summer season	+	(+) The beach is more than 100 but shorter than 1000 meters	+	+

As we can see, there are some deviations from the recommendations, especially in relation to point 3: "Be available for registration throughout the year".

### 1.6 What is the practice in other OSPAR countries?

The work in OSPAR is largely based on the efforts of the member states to follow up measures adopted by the community. It may therefore be relevant in an evaluation to look at how other countries follow up OSPAR's request to establish monitoring of marine litter by using OSPAR's method, and how Norway compares to the others. We will therefore shed light on the OSPAR countries' efforts regarding:

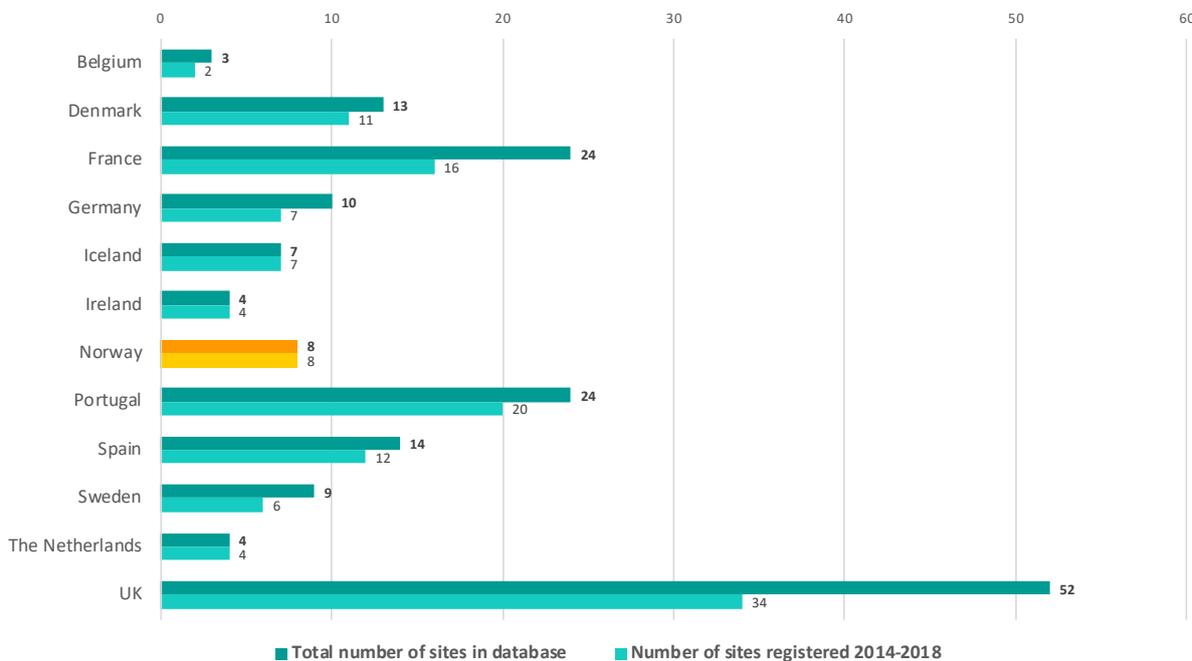
- Number of beaches monitored
- Registration frequency (number of registrations per beach per year)

We will also look specifically at how well "*Region I - Arctic Waters*" is covered, as there are few countries that have shoreline within this region. It is important that this region also has sufficient coverage to be able to say something about the condition.

## Number of Beaches

### Number of OSPAR beaches per member country

Norway, with its seven active OSPAR beaches, has a relatively small number of registered beaches compared to many other OSPAR countries (Figure 5).



**Figure 5. Number of beaches included in the monitoring per OSPAR country.**

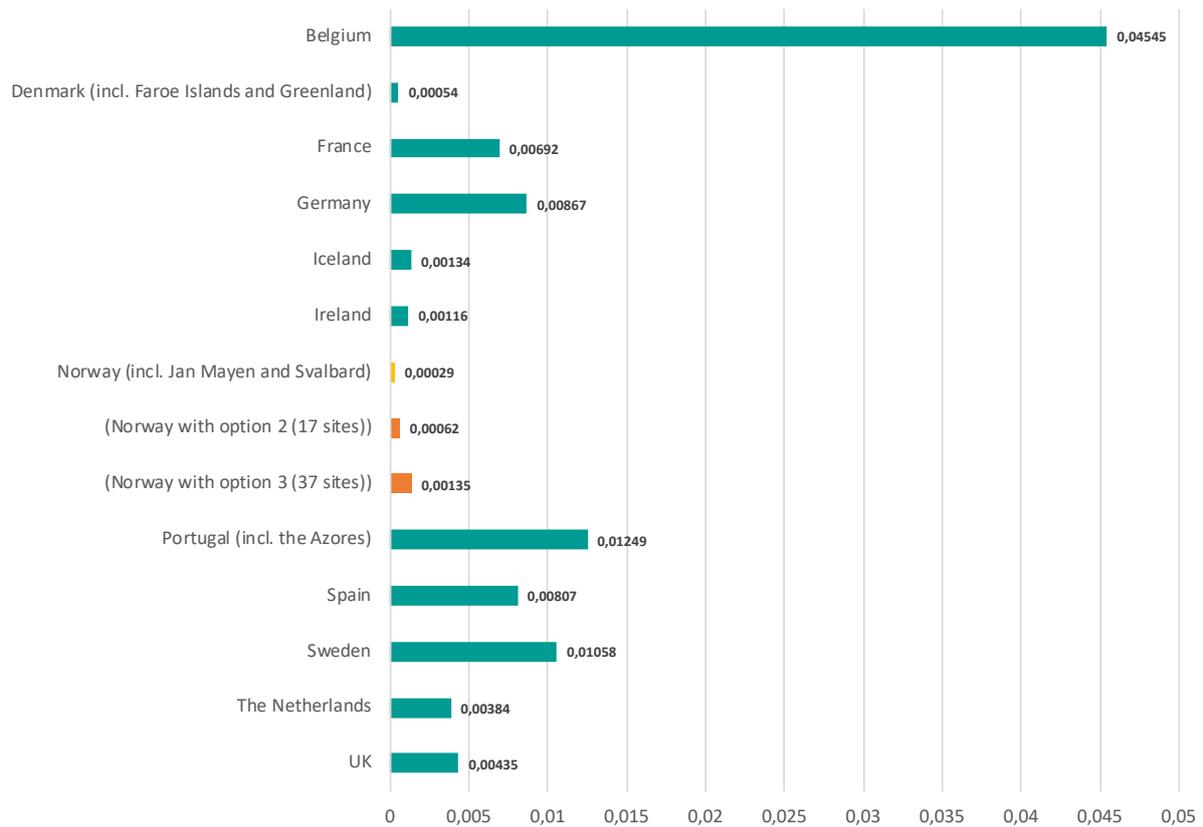
Some beaches have been registered in just a few of the years the individual countries have reported beach litter data to OSPAR, for example because it has been found that some of them are unsuitable or that some have been established in recent times. This is illustrated in the figure by the fact that dark bars show the total number of beaches registered per country, while light bars show the number of beaches registered at least once during the last five years (the period 2014 to 2018). Although Norway has only 7 active beaches, the location of Sandfjordneset is taken into account in order to ensure equal treatment of Norway with the beaches of other countries.

### Number of OSPAR beaches per member country – assessed by the countries’ coastline

The fact that Norway has relatively few beaches compared to other OSPAR countries is particularly evident when considering the length of each country's coastlines (Figure 6).

## Evaluation of OSPAR beaches

SALT Report no.: 1043



**Figure 6. The proportion of coastline covered by OSPAR beaches (number of beaches per km of coastline).**

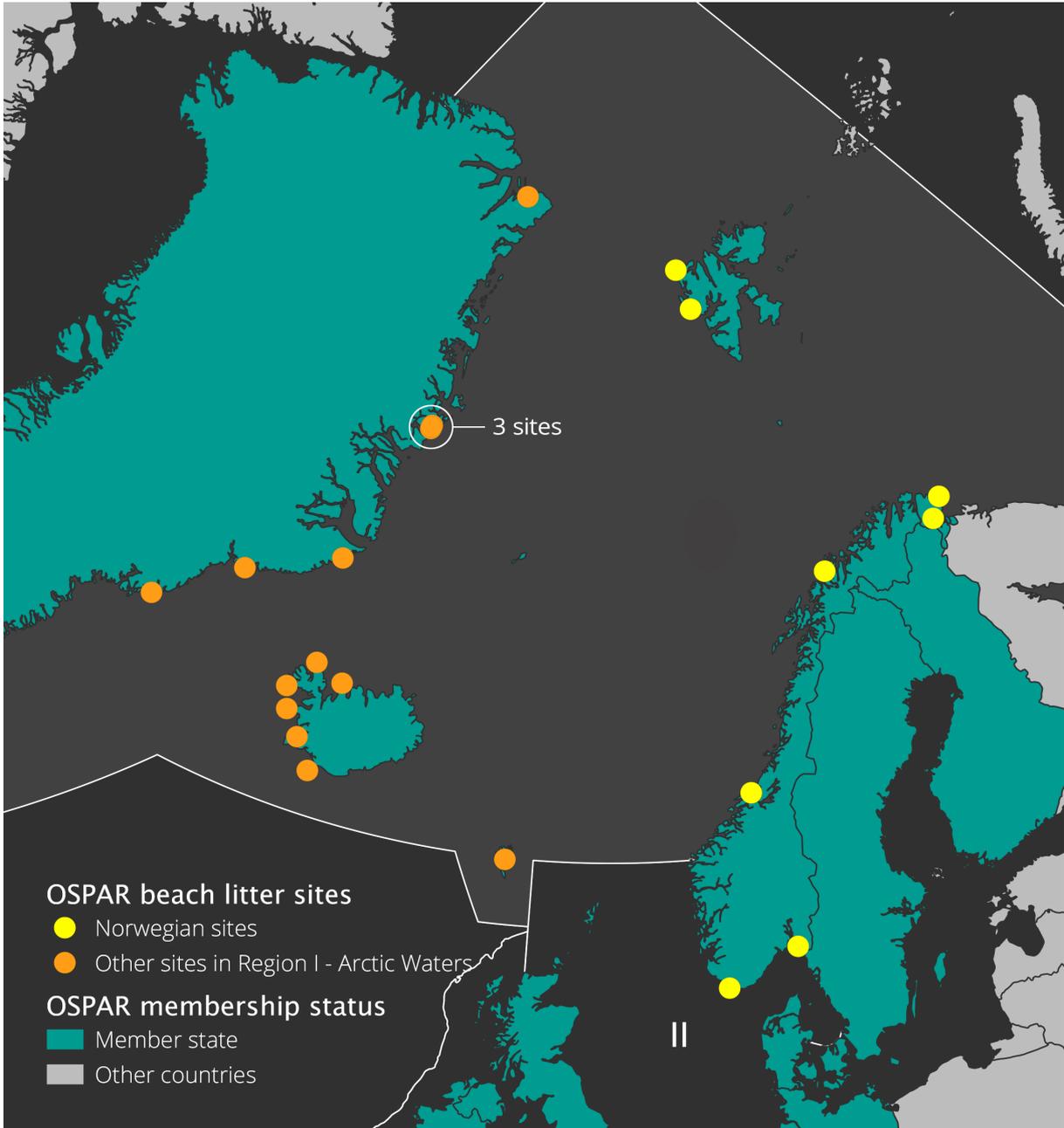
Here, the number of beaches registered in each country is divided by the length of the part of the countries coastline that lies within the OSPAR area. Only beaches that are registered at least once during the five-year period 2014 to 2018 are counted. The coastline within the OSPAR area is calculated in Q-GIS with a map basis: "Natural Earth Data, 10m physical coastline", calculated with coordinate system "WGS 84 - geographical" (EPSG: 4326). This is a less detailed dataset than what is used to calculate official coastlines. This means that the coastline to countries with a complicated coastline and many islands, such as Norway, is shorter here than the official numbers. For countries with a uniform coastline, such as Belgium, the accuracy of the calculation is approximately equal to the official numbers. The calculation was being made because there are no official numbers for the length of the coastline that is within the OSPAR area for all member states. For Norway, two proposed alternatives for expanding the number of OSPAR beaches have also been proposed (see Chapter 3).

The figure shows that Norway has the fewest number of OSPAR beaches per kilometer of coastline of all OSPAR countries. This is partly due to the particularly long coastline of Norway. At the same time, this means that we need more beaches to cover our proportion of the coastline in region I with a representative number of beaches. The relationship between the number of beaches needed to be representative and the coastal length is not necessarily linear, but gives an indication.

As explained in the figure text, the calculated coastline for Norway used in this analysis (27,498 km, including Svalbard and Jan Mayen) is considerably shorter than the official length of Norway's coastline (100,915 km) due to the resolution on the map basis which is used. If based on the official length of the coastline, Norway will come out even worse of the comparison.

### Number of beaches in Region I – Arctic Waters

Only the member states of Norway, Iceland and Denmark (representing Greenland and the Faroe Islands in OSPAR) have a coastline within Region I - Arctic Waters.



**Figure 7. OSPAR beaches in Region I «Arctic Waters».** For Norway, the two beaches that are located in Region II «Greater North Sea» are also included (Illustration: SALT).

Figure 7 shows that there is a total of 20 beaches within this region.

**Iceland**

The six Icelandic beaches shown in Figure 7 were first registered in 2016 (5) and 2017 (1). Additionally, one new beach is registered in 2018. We have not been able to obtain coordinates for this beach.

**Greenland**

The seven Greenlandic beaches that are within the OSPAR area were all registered for the first time in 2016.

**Faroe Islands**

The beach at the Faroe Islands was registered in 2002, 2005 and 2006, and thus has no recent data.

## Norway

Most Norwegian beaches have been registered since 2011 (5). The beaches Ytre Hvaler and Været were registered for the first time somewhat later (Ytre Hvaler from 2012 and Været from 2015). The location of Sandfjordneset is closed and last registered in 2014. Åpenvikbukta, which replaces the latter one, was first registered in 2018. Thus, although eight Norwegian locations are marked on the map in Figure 7, only seven of these are active.

## Intermediate Assessment 2017

In the Intermediate Assessment 2017 (IA 2017), the OSPAR beaches are analyzed for:

- **Trends in the amount of marine waste** (in the period 2009-2014 - at least 15 registrations were required within this period for a beach to be included in the data base)
- **Quantity and composition** (2014/2015)

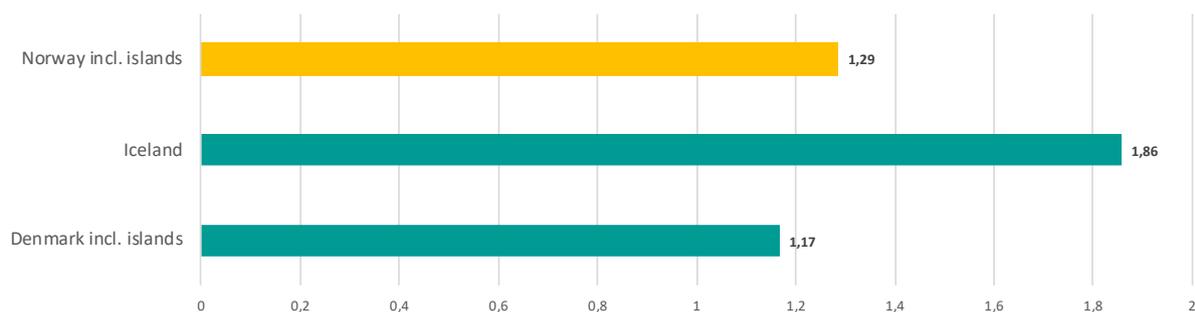
For IA 2017, only five of the Norwegian beaches were available for analysis and constitute the entire data base for Region I, and these could only be used for the analysis done for 2014/2015. On this basis, IA 2017 has concluded that the number of beaches in Region I - Arctic Waters should be increased.

As Figure 7 and the text above show, there is currently greater activity for registration in Region I than before. This is good for future coverage, but at the same time it is the region in OSPAR that has the largest marine areas and longest coastline. Therefore, the need for the number of beaches included in the beach litter monitoring network is high, in order to be able to assess the condition with some degree of security.

## Registration frequency in Region I – Arctic Waters

By registration frequency is meant the number of times each beach is registered per year.

An evaluation of Norway's registration frequency in relation to other OSPAR countries is most relevant in relation to the other coastline countries in Region I - Arctic Waters, as these countries have more similar physical conditions as Norway. We have therefore limited the information on registration frequency below to countries that have a coastline in Region I. Even Norway's two beaches located in Region II - Greater North Sea can be better compared to the other beaches in Region I, as they are located in the very north of their region. We have therefore also included these two beaches in the calculation of the Norwegian average in Figure 8.



**Figure 8. Average number of registrations per year per location per country with coastline in Region I – Arctic Waters.**

Only registrations completed during 2018 are taken into account. For Norway, therefore, only our seven active locations are counted (Illustration: SALT).

As Figure 8 shows, Norway has an average of 1.29 registrations per year at our seven active locations. This means that the data base is considerably less detailed than the four annual registrations recommended by the OSPAR guidelines.

## 2. WHAT ARE THE NEEDS OF NORWAY?

Registration according to the OSPAR method is a relatively time-consuming job at beaches with a lot of litter. It is important to make the most out of these resources. Utilizing the best resources means, among other things, getting answers to the right questions. A clarification about what needs the registrations at OSPAR-beaches should cover, is the starting point for finding the right questions.

SALT has chosen to obtain information on what needs to be covered by a surveillance of macro beach litter in Norway from several resources:

1. We conducted a user-survey among representatives from the environmental administration and among researchers using or wanting to use data from the monitoring.
2. We have obtained information from other sources, including those who are currently carrying out the registration of the seven Norwegian OSPAR beaches and from various relevant reports.
3. We have made an independent assessment of possible future needs.

Our findings are summarized in the following sections.

### 2.1 User surveys

Those who often has the most knowledge about what needs to be covered by the registrations of the OSPAR-beaches are the ones who will use and utilize the data. The two largest groups are **governmental administrations** and **researchers**. It was previously found that the needs between the two might differ somewhat. We will therefore investigate the needs of both users. In addition, those who carry out the registration at each location will have valuable knowledge that also should be considered. We have therefore also spoken with the coordinators for the seven established OSPAR-beaches in Norway.

Below we have summarised the input of those who participated in the user survey.

#### Interview with representatives from the environmental administration

The environmental administration is the owner of the data and pays for the registrations. At the same time, the environmental administration is a potential user of the data, for general monitoring of marine litter and monitoring to assess the effect and compliance of measures implemented.

#### Norwegian Environmental Agency

##### *Integrated marine management plans*

The Norwegian Environment Directorate has no plans to use OSPAR beach litter data in the three integrated management plans for the marine areas. Instead, they want to use data collected at sea within the geographical boundaries of the three plans.

##### *Water management regulations*

Marine pollution does not currently form part of the Norwegian Water Management Regulations, but it has been decided that plastic pollution will be included in the regional water management plans and the associated action programs from now on. This means that all water regions must consider plastics influence on water bodies and, if necessary, take measures to reduce impact.

In work with water management regulations, each water body is assessed in relation to its chemical and ecological state. However, today's OSPAR beaches are too few to constitute any great support in this work. In order for the OSPAR-registrations of beach litter to meet this need, a much larger number

of locations than today's will be required, or that the method is customized in a way so that the registrations become representative to a larger area.

In its recommendation to the Ministry of Climate and Environment, the Norwegian Environment Agency has not proposed which methods should be used to document the degree of impact from marine litter, but the OSPAR method is probably too resource consuming for this use. A simpler form of registration of impact is probably sufficient. However, OSPAR beaches will be of great help in classifying the water bodies within which they are located.

## Interview with researchers

All data on marine litter are potential sources for researchers to learn more about the extent of this environmental problem. But the data must be collected in such a way that it can be used for research.

### NIVA

Researchers at NIVA see source tracking as an important part of the data that should be collected for beach litter. Here, they also point out that it is important that the types of items registered are adapted to the countries involved. It can vary what types of items you find in high quantities from country to country, and it should be ensured that items that are particularly relevant to each country are registered. An example mentioned is biofilm carriers<sup>9</sup>.

Researchers from NIVA consider it important to collect data on weight in addition to the number of items. From a research standpoint, it would be advantageous to get as detailed data as possible. Weighing each OSPAR ID is therefore preferable, but it is clear that this must be evaluated against resource use. With today's technology, it may therefore make sense to weigh the waste at the middle level, per main category (material type). As technology advances have progressed, this may facilitate the collection of data on quantity, and the degree of detail can be increased here as well.

It is important to safeguard the quality of data collected. This can be done by calibration between beaches (for example, the same crew clears / records all beaches), which will ensure that the method is practiced equally, also with regard to accuracy and degree of detail. The use of a professional crew who knows the method well can also help to ensure the quality of the collection. They also point out that a thorough resetting of each beach after each registration is important. This is part of the OSPAR method even today, but it may seem that there is a difference in how closely this is followed up on each OSPAR beach, and that a greater focus is therefore needed on this.

NIVA has worked extensively with technology development in marine waste research. They believe that this will also be important for monitoring beach litter in the future. They refer, among other things, to the development of a tool for scanning plastic types, and future development of technology that will facilitate the work of registration: for example, using a mobile camera connected to a database that recognizes the object and registers it in the form on the correct ID.

NIVA, in collaboration with SALT and several foreign research institutions, is working on an EU application for a project that will seek to harmonize methods for monitoring nano-, micro- and macro plastics within the EU / EEA.

### Institute of Marine Research (IMR)

The Institute of Marine Research sees descriptions of sources of marine litter as an important need. They point out that their modeling of marine litter with ocean currents can contribute to this work, by tracing marine litter discoveries back to the area where it probably originated.

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<sup>9</sup> Small items, usually made of plastic, that are made in such a way that they have a large surface area. In sewage treatment plants, these are used inside large containers as a growing place for bacteria, which purifies the water flowing through the container.

Also, data that can provide information on trends, understood as systematic changes in the amount and composition of beach litter over time, are interesting. They also look at data from registrations using the OSPAR method, together with data from Keep Norway Beautiful, as an opportunity to validate their calculations of coves with particularly high wrack loads / hotspots using offshore models.

IMR believes it is important to evaluate an expansion of the OSPAR beaches in Norway, but the utility value must also be evaluated against the use of models. The models can be helpful in selecting new OSPAR beaches, by demonstrating which areas are believed to collect a lot of beach litter. Their model can also be used to say which locations are most suited to evaluate the effect of measures, if the location of the source (emission point) is known.

A registration frequency of 1-2 times per beach per year is the most realistic to achieve in Norway.

IMR conducts annual registrations of marine litter with trawl in several Norwegian marine areas, which are alternative ways of monitoring marine litter.

## **NORCE**

NORCE also points out that information on sources of marine litter that is registered is important. Knowledge of countries of origin is also important, as this will be relevant to assess the effect of measures being introduced in Norway. Other demands mentioned are the ability to monitor trends in the amount of litter over time. It is also stated that it is important to collect data that can say something about where the litter accumulates - i.e. where we find hotspots / coves with particularly high wrack loads along the coast. This is important in order to better prioritize resources. Data on the weight of the litter in addition to the number will also provide useful information for research. Another need is to provide data to be able to calculate the cost of cleaning up marine litter in Norway. Can OSPAR beach waste data contribute to this? Here it will also be necessary to define where to put the list for cleaning: do we want to return to the pre-1950 level? What vision does Norway have regarding maintaining a clean coast?

It was also discussed whether OSPAR beaches can be compared between Norway and other OSPAR countries. Ytre Hvaler is recognized as the most influenced OSPAR beach, but there are major differences between this beach and beaches typically found in southern Europe. Nevertheless, in Norway one should try to establish OSPAR beaches that are representative of Norwegian conditions, and not just find beaches that are similar to those found in the Netherlands and Belgium. Norway has few long sandy beaches. The substrate is more often rocks of different sizes than sand and gravel. This also presents challenges for the collection of litter, as there is much that is caught under and between the rocks that are not easily found. Some of the litter may also reappear after a period of heavy waves, which should not really be counted as newly arrived waste since the previous registration. OSPAR's recommended selection criteria for beaches mean, among other things, that they should be available for registration throughout the year and available to easily remove marine litter. This could exclude many locations that are representative of Norway. It could also make the locations more accessible for third party litter cleaning, which in turn will affect the reliability of the data.

It is pointed out that today's OSPAR beaches are not sufficient to provide representative data for Norway. There are too few locations and there are large "holes" in coverage between Sørlandet (Southern Norway) and Trøndelag (Mid-Norway), and further north from Trøndelag. This may give a possible incorrect picture of the problem. Therefore, there is a need to expand with more locations, and specifically, it was proposed to consider: Jæren, Øygarden, Herdla, Hardanger (Tysnes) and Nordland (Vega).

NORCE identifies the importance of a governmental monitoring program for marine litter. It will be difficult for individual actors within research to build up such data, partly because of the need for funding. It is also important to collaborate between actors researching marine litter in Norway.

## Interview with coordinators for Norwegian OSPAR beaches

The coordinators have first-hand knowledge of the challenges of the OSPAR method in practical use. Their experiences and assessments of the method are therefore useful in an evaluation.

### Svalbard

The Governor of Svalbard sees a special need to identify sources of marine litter. The composition of the waste is also of interest, and how this change over time (trends).

In Svalbard there is often a lot of wind, and there is little vegetation or wrack zones that holds the waste back on the beach. Much of the marine litter is also blown far up on land, thus out of the area being registered. This should be taken into account when selecting any new locations. There are also some tourist visits to the island, also by cruise ships whose activity is to let tourists participate in marine litter cleaning. It is therefore important to think about which locations are as little as possible visited by others. This also corresponds with OSPAR's recommendations. The Governor collects and registers the litter as part of their other activity on Svalbard. Therefore, if any new locations are considered to be cleaned by them, location should be clarified with them.

It is a matter of prioritizing resources how much time they can spend on this activity. Registration and cleaning of beaches should therefore be included in the management's official assignment to them, especially if the number of beaches is increased. The Governor also has frequent changes of crew members. There are usually new people who do the registration every year. The OSPAR method is complicated and comprehensive. It takes a lot of time for new crew members to familiarize themselves with the method and forms from scratch each year. One solution that can mitigate both limited resources and frequent change of crew can be the sharing of work on the registration of beach litter on Svalbard, where the Governor collects and brings the litter into port, while others make the actual registration of the individual items. This can be done, for example, by the University, the Polar Institute or others.

The time window for this activity on Svalbard is from July to September. In practice, they must perform this work in the context of other assignments. This is best suited from the end of July to the end of August. This means that in practice it is only possible for the Governor to register each beach once a year.

### Rekvik

Here, too, the need to be able to document sources, and variation in sources between regions, is considered particularly important. There is a need for access to quantitative data, which can be used in the national and international context. There is a need for more locations in Norway, in order to ensure yield of the data. At the same time, it is pointed out that promoting and raising awareness that there is a need for such thorough monitoring, apart from all other cleaning initiatives, is a desire in itself. Currently, data from OSPAR monitoring is little used.

In Rekvik, there are many items that are registered that do not have a separate field in the form (i.e. not their own OSPAR ID). Some of these occur in relatively high numbers, and several of them are believed to be more relevant to Norwegian beaches than many southern European beaches. Highway snowplow markers are mentioned as an example. The field for "other items" is often full. Processed wood also presents challenges, as there are many types: trunks, planks with and without impregnation, etc. Type of wood is important to be able to say something about the source and the background for it to have entered the wilderness, such as cut-offs of impregnated wood. The opportunity to make national adjustments to the form was also discussed.

Rekvik and Ytre Hvaler are the two OSPAR beaches in Norway that register the highest number of items (Falk-Andersson *et al.* 2019). In Ytre Hvaler, transects within the 100-meter section are used for registration, because registration of such large amounts of litter requires a lot of resources. For Rekvik, there is also a need to be able to make use of registering transects within the 100-meter

stretch to make the cleanup more efficient, and to release resources to be able to register more accurately or to be able to register several beaches in the same region. However, this must be seen in relation to the time series worked out and the effect of adjusting the method of registration on this.

In the interview, we discuss that in order to obtain significantly more information about the magnitude of litter, one could have weighted the litter in addition to registering the number. However, for the very largest items, such as parts of nets / trawl bags, it may be difficult to weigh these in the field.

When choosing new locations for possible expansion of the number of OSPAR beaches in Norway, geographical distribution is mentioned as important. Consideration must also be given to what one wants to get from the data collected. A form of randomized selection of new locations is mentioned as a way to increase the statistical power to say something about larger areas based on the beaches being monitored. Specifically, the south-west side of the Oslo Fjord, Northeast of Bergen, the Ålesund area, Helgeland, the West Fjord and Finnmark west of the North Cape are proposed as relevant areas. It is suggested to select two locations in each area, of different types. The substrate at Rekvika, which consists of pebbles, presents a challenge for the registration of the smallest items. This should be taken into account when choosing new locations.

It is mentioned that the amount of litter registered in Rekvika would decrease considerably if the location was moved 100 meters to one side of the current location. Rekvika is, as its name suggests, a typical "cove" with particularly high wrack loads, with ocean currents and winds that carry a lot of marine litter into the bay. It is highlighted in the interview that there is a need to register such locations, in order to show that there are several exposed locations with a lot of litter along the Norwegian coast, but also because such locations provide a high resolution of data on the composition of marine litter. This is precisely because of the large number of items.

Regarding the frequency of the registrations, it is pointed out that this must be adapted to the climate in each area. It seems that north of Lofoten it will be difficult to register more than twice a year, and for some places in Finnmark and far north, maybe only once.

### **Ytre Hvaler**

It is important that there are permanent professional cleanup teams that clean and register the individual locations each year and that the cleanup teams should regularly exchange experiences. It is also important that the method is followed exactly on all beaches. These are elements of the quality assurance of the data collected that should be followed up. If SNO does not actively participate in the cleanup team, it is nevertheless important that SNO is involved in monitoring the beaches and any dead animals that is found. It is also important that the beaches are representative of the inflow of marine litter in their area / region.

To use the data, it is important to be able to identify sources of the litter. The OSPAR method only partially meets this need. More source categories would provide better mapping of sources. It is referred to the method Beach Litter Deep Dive used in the Oslo Fjord in 2018 and 2019, which is a method developed by SALT and adapted to conditions in the Oslo Fjord, as an alternative that will provide better information on sources.

The categories/ the types of items that are registered should also be representative of Norway. There are currently many types of items that fall outside of the official categories (OSPAR IDs) in the form reported to OSPAR, which can provide important knowledge about the types of items and sources of these that should have been considered for follow-up with national measures. Although it is possible to identify many of these items, these are currently listed under the "other" category (OSPAR ID 48), with explanatory text on the registration form. But these types of items are not made visible or captured in any way after reporting, nor nationally. Examples of such items are parts from crab / lobster traps (i.e.: black plastic covering their metal parts, and which is falling off after a period of use. These have rust and a clear pattern after the metal on the inside, which can identify these plastic pieces), plastic bags (packaging) for professional fishing gloves, blasting tubes (hollow, thin plastic

tubes of different colors used to trigger explosives in tunnel excavation), fragments / parts from road brushing machines, fiber rebar, etc. All of these items exist in relatively large amounts. There are also different practices on how these and other types of items are registered between the seven Norwegian beaches. This can lead to sources of error when using data in retrospect. An example: Should loose plastic labels from bottles be counted under ID 4 drinking bottles or ID 46 unidentified pieces of plastic between 2.5 and 50 cm (although identifiable)? It would also be interesting to distinguish between plastic types (PE, PP, etc.), but this will require some more development on the technology side.

The selection of OSPAR beaches in Norway should be representative of the entire coast. Compared to other countries, we have few OSPAR beaches in Norway in relation to the length of the coastline. For example, there is a large "gap" between Lista and Været. Western Norway and Nordland / Lofoten as well as Marine National Parks (Lofotodden, Raet, Jomfruland and Færder) are proposed as potential areas that should be considered. For the selection of any new locations, a set of criteria should be created that follow OSPAR's recommended criteria, but which is also adapted to Norwegian conditions and needs.

In the Oslo Fjord area, it will regularly be possible to register three times a year. The months of January to March are difficult, as there is often a lot of snow and ice covering the beaches during this period. The number of registrations can also be increased for Ytre Hvaler, but this is a matter of resources. A change now could also break established time series of data from the beach.

### **Været, Kviljo, Sandfjordneset and Åpenvikbukta**

These four locations are registered by the Norwegian Environment Agency's operative field branch (SNO), which is a department under the Norwegian Environment Agency. The Sandfjordneset location has been phased out, and the last registration was made in 2014.

For SNO, mapping of accumulated and floating litter nationally and regionally on the outer coast is stated as a need. As of today, the need is not adequately covered, because the station network is limited and because several locations are too exposed.

SNO recommends choosing beaches that are representative of Norway. This may mean choosing beaches that do not necessarily meet all the criteria recommended by the OSPAR guidelines, among other things for substrates. When choosing several beaches, SNO propose to prioritize locations that are exposed to the open sea, as well as to tighten obvious gaps between the existing locations: Vestlandet between Bergen and Trøndelag, and Nordland south of the West Fjord. They consider that an estimated 8-10 locations may be adequate. The number of annual registrations per location must be adapted to weather conditions, but it is estimated that 1-2 registrations are realistic.

## **2.2 Information from other sources**

### **Report from workshops on the work of OSPAR beaches in Norway**

Two workshops have been held for those involved in the registration of beach litter according to the OSPAR method in Norway. Both meetings took place in Tromsø and were arranged by the Directorate for Nature Management / The Norwegian Environment Agency in collaboration with Bo Eide from the municipality of Tromsø.

The purpose of the workshops was to establish and strengthen the contact between those involved in the work on the individual beaches, exchange experience from the work and calibrate the different locations against each other with respect to the method. It was also a goal to discuss challenges with registration and to work out suggestions on how we can get a greater benefit from the work, as well as concrete measures to reduce the scope of the problem. The workshops have also helped to give the coordinators more insight into the work on marine litter in OSPAR in general and knowledge of the

work that is behind the registration method for beach litter in particular. In both workshops, field excursions were arranged, where methodology was practiced and discussed.

## 2012

The first workshop was arranged on October 16-17, in 2012. Issues that were discussed in particular were:

- There are large quantities of items of certain types of litter (in particular: OSPAR ID 32 "*String and cord diameter <1 cm*" and OSPAR ID 117 "*Plastic / polyester pieces 0 - 2.5 cm*"), and this provides challenges when registering at the most polluted beaches.
- Need for national adaptations: own photo guide for Norway, splitting of certain types of items into several subtypes, registration periods adapted to Norwegian conditions.
- Need for applying the results for both dissemination and targeted measures against specific sources of items that are widely found on the beaches.
- Particular types of litter that stand out and are found in large numbers (types, sources, specific brands), and what one can do in order to prevent them from becoming marine litter.

## 2019

The second workshop was arranged on September 18-19, in 2019. Many of the same questions from the discussion in 2012 were still relevant. Challenges specific to each beach were discussed. It was informed that SOMM is taking over responsibility for the national coordination of monitoring of beach litter from the Norwegian Environment Agency. It was also discussed whether the number of locations for registration according to the OSPAR method in Norway should be expanded. Færder National Park was proposed as a specific location. Several pointed out that there is a great distance between the five existing locations on the mainland, and that especially Vestlandet and Ofoten/ Lofoten may be relevant to consider. It was also proposed to expand the number of locations on Svalbard.

## Report from workshop on indicators of marine litter

In 2016, the Norwegian Environment Agency invited selected researchers and bureaucrats to a workshop on indicators for marine litter. The purpose of the meeting was to gather information on data collected about marine litter at that time and known future plans for collection of data. The plan was for this to form the basis for the development of specific indicators, which could, among other things, be used in the Norwegian integrated marine management plans. To our knowledge, this work has not been followed up. The report from the workshop<sup>10</sup> is nevertheless a good basis for listing what data sources exist about marine litter in Norway. Please see section "Other relevant methods" below for descriptions of new projects and methods that supplement the information in the 2016 report.

## 2.3 Other relevant methods

When the OSPAR method was chosen as the method for monitoring the scale of marine litter in Norway, this method was about the only one of its kind. It was also an expectation to be able to report the extent of marine litter to OSPAR. Since then, alternative methods have been developed that are targeted to answer specific questions such as quantity, cause of littering, or age and nationality determination. Furthermore, several ongoing parallel projects are exploring the possibilities of registering litter from satellite or drones. The use of ocean current models and drift models together with GIS models will help to understand transport and deposition of marine litter.

SALT consider it important to know other relevant methods and accumulated data to include them in the assessment of whether extended use of the OSPAR method should be supplemented by other

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<sup>10</sup> <https://www.miljodirektoratet.no/publikasjoner/2016/april-2016/indikatorer-for-marin-forsopling/>

methods. In the following, we will therefore describe the most relevant alternatives and data sources and highlight their strengths and weaknesses / limitations.

**Delimitation**

The overview below only describes **Norwegian** methods for mapping or monitoring of **macro beach litter**, and that are considered good methods for improving mapping and monitoring with supplementary information which the OSPAR method itself does not capture.

Methods developed primarily for monitoring marine litter in the water column, on the seabed, in biota or for size fractions from microplastics and downwards are not included in the overview.

<b>Marine debris Action Planner (MAP)</b>	
<i>Short description</i>	<p>SALT develops a GIS-based predictive model to quantify beach litter. In addition, relationships between amounts of litter and proximity to local sources, such as population density in the area, distance to the nearest road, river and harbor, and the amount of nearby fishing activity are investigated. There is a distinction between litter from sea-based sources and litter from land-based / unknown sources.</p> <p>The model is based on identifying the characteristics of the coastline that affect the potential for litter accumulation. For example, work with slope has revealed a clear threshold value where high density of litter is extremely unlikely if the shoreline is steeper than approximately 20 degrees. Other factors being investigated include coastline shape, orientation relative to wind and weather, and substrate.</p> <p>Since the selection of sites is randomized and stratified, we can assume that the data is representative of a larger area / region.</p> <p>The model is quantitative and based on extensive field work. The model therefore differs from most other beach litter-hotspots modeling work, as it is based on actual beach litter registrations.</p>
<i>Owner of method</i>	<b>SALT</b> og <b>GRID-Arendal</b>
<i>More information</i>	<a href="https://www.sciencedirect.com/science/article/abs/pii/S0025326X18308762">https://www.sciencedirect.com/science/article/abs/pii/S0025326X18308762</a> (note that this describes the pilot project and not the exact method used today)
<i>Assessment of relevance for Norway</i>	<p>Can be used to select new OSPAR beaches.</p> <p>The method can be used for monitoring data that is representative of a larger area / region, but this will require development of a plan for how many registrations must be completed per year and which areas to cover.</p> <p>Analysis of variance could provide information on how many OSPAR beaches will be needed to provide some representative data for the most deprived areas.</p>
<b>+</b>	<p>To date, the only method that secures representative data and can be used to compare regions / countries.</p> <p>Since it is representative, it is also the only method that can currently be used to quantify and provide estimates (with confidence intervals) of total quantities of litter along the coast in given regions / countries.</p>

	<p>The model is very effective in eliminating locations with low probability of beach litter accumulation.</p> <p>This can be a useful tool for determining / selecting locations for collected litter and planning of national cleaning actions.</p> <p>Applicable for all kinds of regions and especially for heterogeneous coastlines.</p>
÷	<p>The registration per beach is time- and cost effective, but large amounts of data (i.e. the number of beaches) are required, and the method is therefore time consuming and labor intensive within the investigation period.</p> <p>If the method is to be used for monitoring over time, a separate protocol must be developed for this, especially considering how often data is to be collected and how much.</p> <p>Although the model is good at identifying locations with low probability of beach litter accumulation, it has so far shown limitations in identifying beach litter-hotspots. Because of this, in the further development of the method, the thinking shifted from primarily identifying hotspots and contributing in cleanup planning to pure quantification and estimation of amount and variance.</p>

Beach Litter Deep Dive	
<i>Short description</i>	<p>Through analysis of beach litter in collaboration with litter experts, SALT has developed the concept idea "Beach litter deep dive". The litter experts are people with a lot of experience in beach cleaning, as well as industry actors who represent the largest activity in an area, and thus potentially important sources of litter. By learning from the litter experts, SALT has gained knowledge about the litter, which both identifies potential sources (that is, actors you should engage in dialogue with for preventative measures) and behavioral trends behind poor waste management that leads to littering. Beach litter deep dive has identified different source categories that are weighed to give a better overview of the contribution of different sources to marine litter in weight.</p> <p>In many cases, to identify the sources and the reasons behind that litter ends up in the sea, higher resolution than what emerges from other registration methods is required. Especially in dialogue with actors who are representing the source of the litter and preventative measures, it is important to have good documentation for the actors to see and take responsibility.</p> <p>Beach litter deep dive is a supplement to existing monitoring. The idea behind Beach Litter Deep Dive is not to replace existing beach cleaning protocols but is a method that will go more in depth, especially on identifying sources and causes, and will therefore be supplementary. For example, the deep-dive method has taught us to identify litter from the fishing industry that is very likely to be dumped (clean cuts of rope). Furthermore, the method has been used to identify the age and country of origin of bottles and containers. This is valuable information in order to be able to monitor whether marine litter measures are effective.</p>
<i>Owner of method</i>	<b>SALT</b>
<i>More information</i>	<p><a href="https://salt.nu/wp-content/uploads/2019/04/1024-Dyppykk-sluttrapport.pdf">https://salt.nu/wp-content/uploads/2019/04/1024-Dyppykk-sluttrapport.pdf</a></p> <p>See also Drægni et. al. 2019.</p>

<p><i>Assessment of relevance for Norway</i></p>	<p>Considering the user survey, mapping of sources of marine litter has been identified as an important need by several respondents. Beach Litter Deep Dive can be an effective way to provide more information about the sources of litter registered on OSPAR beaches (or on other beaches that are part of a future national multi-method monitoring network).</p> <p>Identifying the sources of the litter is relevant both to provide knowledge of the measures that should be considered to be implemented to reduce the influx of marine litter and to monitor the effect of the measures implemented.</p> <p>The method may also be relevant for establishment to other OSPAR countries.</p>
<p style="text-align: center;">+</p>	<p>One can tell both source and behavior, which will not be visible through existing statistics.</p> <p>Provides knowledge about beach litter which can more accurately say something about the source, measures and behavior behind littering.</p> <p>Dissemination and discussion in conjunction with deep-dive workshops with stakeholders, including actors who may be the source of the litter or have management responsibilities, have several benefits.</p> <p>Part of the concept is to arrange workshops with experts who give them great familiarity with the litter and who provide increased insight and knowledge in order to initiate action. This also affords knowledge of what is probably lost versus dumped by explaining the area of use / value of the items.</p> <p>Can be adapted locally (the method can obtain sources of litter in a given area, such as the Oslo Fjord).</p> <p>Flexible method (<i>"Do you see any important or particular beach litter? Note this and include it in the registration form"</i>).</p> <p>Potential for more management-relevant data collection.</p> <p>Provides more accurate knowledge of sources of high resolution.</p> <p>Can be used to answer specific "research questions".</p> <p>Registers both in number and weight.</p>
<p style="text-align: center;">÷</p>	<p>In order to achieve synergies between deep-dive and other projects by combining field work, these should have the same requirements for location and similar requirements for type of data registration.</p> <p>It is recommended that those who are conducting deep dive are experienced in the method.</p> <p>The method is relatively time-consuming. This is especially true in deep dives with litter experts and deep dive workshops, which are less effective in terms of data volume than pure registrations, as discussions and dissemination are part of the purpose of these.</p>

**Modeling hotspots for marine litter**

*Short description*

Institute of Marine Research (HI) has developed a mapping tool, which shows potential "coves with particularly high wrack loads" for which plastic has ended

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	<p>up along the Norwegian coast. HI uses its own, already established, ocean current models to calculate the probability of collected litter.</p> <p>HI acknowledge the supply of litter for better indications of how the plastic's movement patterns in the sea looks like. Only information about ocean current conditions is used to calculate the probability of plastic ending up at beaches.</p> <p>Fictitious plastic particles are modeled over a long period of time, representing the variations in ocean currents for the area, before the number of particles that can get so close to land that they can potentially end up on land is counted.</p>
<i>Owner of method</i>	<b>Institute of Marine Research</b>
<i>More information</i>	<a href="https://www.tu.no/artikler/de-har-snart-kartlagt-hele-norskekysten-pa-det-verste-stedet-er-det-inntil-7-tonn-plast-per-kvadratkilometer/444202">https://www.tu.no/artikler/de-har-snart-kartlagt-hele-norskekysten-pa-det-verste-stedet-er-det-inntil-7-tonn-plast-per-kvadratkilometer/444202</a>
<i>Assessment of relevance for Norway</i>	<p>The method does not provide direct information on sources or actual amounts of marine litter and is therefore not a pure alternative to the OSPAR method but can supplement it.</p> <p>The method can be used to trace known deposits of beach litter back to the area where it was released, and thus potentially to the source of emissions.</p> <p>May give an indication of where marine litter from other countries or specific sources ends up along the Norwegian coast.</p>
+	<p>May give an indication of where marine litter from other countries or specific sources ends up along the Norwegian coast.</p> <p>Can be used to trace known pollution back to the emission source.</p>
÷	<p>Does not provide direct information on sources of beach litter.</p> <p>Does not provide information on real amounts of marine litter and variation in quantity over time.</p> <p>Requires detailed and accurate information on ocean current conditions, flowability and other relevant physical parameters for different types of litter, as well as sources (both release points and relative amounts these); inaccurate assumptions about the latter have a particularly strong influence on predictions (Critchell and Lambrechts, 2016). Here, a lot of knowledge is still lacking in Norway.</p> <p>A pure model that is not yet verified with field data. A validation using data from the Norwegian OSPAR registrations and HNR is planned to be completed in 2020.</p> <p>Is intended to model how a particle / object is moved by ocean currents but requires knowledge about emission points.</p>

<b>Adopt a beach</b>	
<i>Short description</i>	<p>“Adopt a beach” is an all year offer for committed persons, associations and companies that will help clean along the coast, waterways and lakes. The goal is to establish 100 adoption groups throughout Norway where each group takes responsibility for cleaning and registering marine litter on a fixed area / beach at least three times a year. Registration is done via HNR's cleaning portal.</p>

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	<p>There are three different levels of adoption; with own cleaning methods with varying degrees of complexity in cleaning and registration:</p> <ul style="list-style-type: none"> <li>- Level 1 is the simplest method. The registration involves a "Top 12 list"; here all the litter is cleaned and weighed but only the 12 most common findings (indicators) are counted and registered.</li> <li>- Level 2 is the «Keep Norway Beautiful (HNR) method». Here, all the litter is cleaned, roughly counted, registered and weighed.</li> <li>- Level 3 is the «Nordic method». It is desirable for all countries to clean and register three different types of beaches where all the litter within a defined area (transect) is cleaned, roughly counted, registered and weighed according to given guidelines and categories. The same cleanup form is used in all countries and contains fewer categories than HNR's own form.</li> </ul>
<i>Owner of method</i>	<b>Keep Norway Beautiful (HNR)</b>
<i>More information</i>	<a href="https://holdnorerent.no/adopterenstrand/">https://holdnorerent.no/adopterenstrand/</a>
<i>Assessment of relevance for Norway</i>	<p>Given that sufficient number of beaches with good distribution along the coast are monitored and that those who participate are given good training in the mapping methods, this could potentially be an alternative to the OSPAR method.</p> <p>Relevant nationally and internationally for "citizen science" and for the distribution of data for research.</p>
<b>+</b>	<p>User-friendly and users can decide how detailed the cleaning and registration should be.</p> <p>Regular intervals for cleaning of the same group. This provides continuity of interval and registration.</p>
<b>÷</b>	<p>Variation in method usage, regularity.</p> <p>Provides very limited weight information, only estimated total weight (the method can be improved by including real weighting of collected litter).</p> <p>Provides little information about sources.</p>

<b>100 pieces of plastic</b>	
<i>Short description</i>	<p>100 pieces of plastic are collected from selected locations. The analyzes of these pieces are used to map the source and type of plastic on the beaches. The purpose is to map geographical variation in the composition of marine litter.</p> <p>The method is new, and not yet developed. Among the details that remain is to decide how to carry out the selection of plastic pieces.</p>
<i>Owner of method</i>	<b>Norwegian Polar Insitute</b> (Geir Wing Gabrielsen)
<i>Assessment of relevance for Norway</i>	The method can be used to get a better overview of sources and types of plastics but will not be able to say anything about quantities. It must therefore be regarded as a complementary method.
<b>+</b>	Easy and relatively cheap to perform.

	Data collection can be done by locals, while identification is done in the lab by professionals.
÷	Can be affected by random variance. Determining the type and source of small plastic fragments can be difficult.

### Other relevant projects

In addition, there are several projects that use existing data sources and methods to survey the occurrence of marine litter and ongoing development of new technology that in the future may provide more information about marine litter. Here is a selection of these:

- **Mapping hotspots for marine litter using drone and aerial photography** (NORCE)

NORCE is working on mapping of coves with particularly high wrack loads in Hordaland to make beach cleaning more effective. The map under development is primarily based on aerial photographs from Norway Digital, observations from voluntary teams and organizations, HNR's cleaning portal and Bergen and surrounding areas' Outdoor Council (BOF) mapping service. The map shows hotspots for plastic junk. The survey helps municipalities to see where the most plastic accumulates, and where the plastic comes back after cleaning. NORCE describes this as the first step in establishing a monitoring program of plastic accumulation in the archipelago.

- **Smartphone scanner for marine litter** (NIVA)

Smartphone scanners containing a Near InfraRed (NIR) camera. The purpose is to be able to detect plastic type in micro and meso plastic. Unidentified plastic pieces can be inserted into scanners that detect the type of plastic using NIR, which recognizes the light spectrum in different plastic polymers. The idea is that in the future, a NIR camera can be placed on drones to detect plastic types on items that include marine litter. Such a camera is also considered to be incorporated into ordinary smartphones. This can provide great opportunities in "citizen science" with regard to, among other things, sorting of litter and recycling of plastic types, and also to identify types of items when mapping according to the OSPAR method or other methods.

- **SeaBee** (a collaboration between NIVA, NTNU, Norwegian Computing Center, NINA, HI and GRID-Arendal. Andøya Space Center og SpectroFly ApS are industrial partners.)

The pilot project SeaBee will establish a national center for drone-based services for use in coastal and water research, mapping, and in monitoring habitat types, algae and animal communities and man-made impacts. Using drones (small portable unmanned aerial vehicles (UAVs)) and machine learning (pattern recognition), the project will automate data collection and analysis, provide high-quality data, and at the same time reduce costs associated with data collection. Further development in the project will be to quantify plastic and marine litter at sea and in the beach zone.

- **A deep dive into the plastic ocean** (Mepex, together with Keep Norway Beautiful (HNR), The Future in Our Hands and Infinitum)

The aim of the project is to quality assure data registration by volunteers during beach cleaning operations, as well as conduct an extended analysis of a random selection of litter collected during the operations. The results from the project will be used to estimate unit weights, i.e. compare the weight of items with the number of items. A sub objective of the project to analyze and document the number of different plastic materials (with NIR scanner) and identify source and the original product as far as possible. The scanner can also map quantities of Norwegian drinking bottles and cans when reading the pledge label. The overall goal of the project is to gather valuable information on the source, cause of loss and composition of marine litter that can be

used as a basis for policy formulation. The project uses various established methods and tools and is not a separate method.

## 2.4 Can the OSPAR method be improved nationally?

Data reported to OSPAR must follow the same method that all other OSPAR countries use. However, there is nothing in the way for Norway to collect supplementary information in addition, which does not need to be reported to OSPAR, while at the same time making the regular registrations.

### Weight

A very relevant national adaptation may be to weigh the waste that is registered. This will provide information that can counteract the disadvantage that small and large items initially count equally in OSPAR's ordinary method. Weight in addition to number is therefore mentioned by several as a need in the user survey.

The cost of purchasing the necessary weighing equipment is modest. In general, a simple hanging weight scale is sufficient. Weighing can be done on several levels, with increasing degree of detail (Table 4). For weighing each category individually, a weight with finer resolution, such as a kitchen weight scale (best suited in the lab) or a hanging weight scale with a higher accuracy for lightweight items, may also be needed for categories where you find little waste. Very large items, as part of a net / trawl bag of around half a ton, can be a challenge to weigh in the field. These will, however, usually require transport by vehicle and can therefore be weighed at waste reception facilities.

From a research perspective, the more detailed the data, the greater the opportunities it gives for using the data. In this case, it would be best to weigh each OSPAR ID separately. Of course, this must be evaluated against the use of resources that this will entail.

**Table 4. Three ways to weigh the waste, with varying degrees of information and requirements of resources.**

Weighing method	Description
<b>1: Weighing everything together</b>	All the waste that is removed as part of the registration is eventually weighed together.  This is the method used today to weigh the waste on the two OSPAR beaches in Svalbard, for reporting to MOSJ. The form they use has the ability to register by material type, but there is overall weight that is reported in MOSJ.
	<b>+</b> The least labor-intensive way to weigh.
	<b>÷</b> Provides less information than the other two methods.  If large, heavy items drift ashore on the beach, this could have a major impact on overall weight.
<b>2: Weighing per main category</b>	If each individual group of litter is weighed separately (the main groups in the OSPAR method consist of different material types, as well as sanitary and medical waste), this will provide additional information about the waste - both for use in research, but also to provide better overview over quantities of different types of waste for management purposes - for example to give a better indication of the effect of measures.  However, this will require each main category to be collected separately during registration.

	+	More detailed information on each main category.  For example, if large (air-filled) metal items drift ashore, their weight will be registered on the main metal category and will not affect the weight of the main category of plastic.
	÷	Somewhat more resource-intensive than weighing everything together (see also the text below, which applies to both methods 2 and 3).
<b>3: Weighing all categories separately</b>	The most resource-intensive way to weigh the waste, but at the same time the one that provides the most information, is to weigh each category of items (OSPAR ID).	
	+	Significantly more detailed information on each category of items and provides the best foundation for measuring the effect of measures and general changes in waste amounts over time.
	÷	More resource demanding than weighing everything together (see also the text below, which applies to both methods 2 and 3).

Methods 2 and 3 for weighing described above entail more work and potentially, on some beaches, you have to go from registering items directly on the beach (as the OSPAR guidelines recommend) to having to collect all the waste first, sort the different items in different categories (IDs) and then finally count and register items within each category. However, this approach is a deviation from the guidelines, and it should be considered whether this is desirable to implement for all beaches. Sorting all items into their own containers as they are registered on the beach is not feasible in practice for beaches with more than minimal waste, with 112 different types of items to be registered in separate fields. An alternative is to do both, register items while picking them on the beach and then sort them into different categories that are then weighed, but that involves a lot of extra work.

### Splitting categories

The categories defined in the OSPAR method must be included in the reporting. However, in some cases it may be appropriate to split one or more of these categories into subcategories (see Figure 9). This will not affect the quality of OSPAR's reports, as long as you register the number for the categories determined by OSPAR.



**Example:**

Norway decides to impose a ban on shotgun wads made of plastic.

In the OSPAR beach litter survey form, the category “shotgun cartridges” (OSPAR ID 43) includes both empty shells and shell wads.

However, it would be highly useful to distinguish the two on Norwegian beaches to monitor the effect of the national ban on plastic shell wads. Doing so is unproblematic with respects to reporting survey results to OSPAR provided the two-categories are summed to equal OSPAR ID 43 upon reporting.

**Figure 9. Example showing the purpose and procedure of splitting categories into subcategories.**

However, it should be noted that the number of categories used in the OSPAR method is already high, and that splitting into a large number of subcategories could result in increased resource use and inaccuracy in registration.

**Combining several methods**

By using multiple methods at the same time, which complement each other, good synergies can be obtained for monitoring beach litter.

One example might be to record all the waste according to the OSPAR method, weighing all the different types of items (OSPAR IDs) separately, and at the same time conduct a deep dive of all the waste collected on a beach for each registration. Then you will achieve:

- As before, reporting to OSPAR
- Increased knowledge of quantities, by registering weight for national use
- Increased knowledge of sources, through deep dives

A more complete version of such a combined method is described as alternative 4 in Chapter 3.

### 3. ANALYSIS

#### 3.1 Outlined needs

Based on the implemented user analysis, other sources and our own assessments of the needs that are relevant for the collection of beach litter data, we have listed identified needs in Table 5 below.

In the table, we have considered whether the current coverage of beaches monitored by the OSPAR method covers these needs, and how any expansion of this monitoring can improve the coverage of the needs.

**Table 5. Effects of expansion on identified needs.**

The background colors in the last column indicate whether the current need will be better protected by an expansion of the network (green color) or whether an expansion does not affect the need (yellow color). There is not discovered any need that will be less covered by an expansion, other than the need to keep the costs of monitoring down.

Needs	Coverage of identified needs	
	Today’s OSPAR beaches	Expansion of OSPAR beaches
<i>Reporting to OSPAR</i>	<p>There is no legal requirement from OSPAR for member states to carry out beach litter registrations, as this measure is adopted as an "Agreement". However, reporting beach litter data is strongly encouraged.</p> <p>Also, there are no requirements for the number of beaches to be reported on.</p> <p>The current scope thus satisfies Norway's legal commitments, but at the same time it is pointed out in the Intermediate Assessment 2017 that: «<i>There is poor coverage for some parts of the North-East Atlantic coastline, for example, the Bay of Biscay and Arctic Waters lack sufficient numbers of survey sites and coverage on the west and northeast coasts of the North Sea should be improved.</i>». However, several new beaches have been added in the Region I - Arctic Waters in the time since IA 2017 was developed.</p>	<p>There is no requirement from OSPAR that the number of beaches registered in Norway should be increased.</p> <p>Although today's reporting meets Norway's legal obligations to OSPAR, an expansion will help gather more information about beach litter within the OSPAR area - and in particular help improve data for beaches in Region I - Arctic Waters.</p> <p>Based on an assessment of the number of beaches in relation to the length of the coastline of the member states, Norway has a low number of beaches compared to many other countries. This suggests that Norway should consider increasing the number of beaches, in order to contribute to better mapping of Region I.</p>
<i>Identifying sources</i>	<p>Source tracking / identification of sources is mentioned by many of those who participated in the user</p>	<p>Reinforcing the method used on the OSPAR beaches can improve the accuracy of source tracking. This can</p>

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	<p>survey as one of the most important needs.</p> <p>Information on sources are important in order to be able to impose appropriate measures to reduce the input of waste to the marine environment. Assigning responsibility to sectors and actors that contribute more to the marine litter than others may also be relevant.</p> <p>Currently, by using the OSPAR data, the registered litter can be traced back to the source of some of the items being registered. However, for the categories that make up the largest proportion of beach litter, accuracy is not the best.</p>	<p>be done by using other methods to examine the collected waste more thoroughly, for example by using "deep dive" (see discussion in the section "Other relevant methods").</p> <p>A national fragmentation of certain OSPAR IDs into several subtypes that are better adapted to what we find a lot of on Norwegian beaches will also provide more accurate information about sources.</p> <p>Expanding the number of beaches will provide more knowledge about the geographical variation of different types of litter and sources along the coast and may increase knowledge of local sources that measures should be taken to address.</p>
<p><i>Identifying preventive measures</i></p>	<p>Data from the OSPAR beaches in Norway are not currently much used to identify preventive measures.</p>	<p>An expansion of the number of beaches will provide better opportunities to identify preventive measures, as it will give a clearer picture of the types of items that are dominant among beach litter along the coast.</p>
<p><i>Evaluating the impact of measures</i></p>	<p>As far as we know, data from the OSPAR beaches in Norway are not currently used to evaluate the effect of the measures implemented.</p>	<p>An expansion of the number of beaches will provide better opportunities to evaluate the effect of measures against marine litter - at both national and local levels.</p> <p>A good example of such usage may be to evaluate the effect of the restriction on disposable plastic products.</p> <p>Local-level evaluation could be enhanced by establishing beach litter monitoring using the OSPAR method downstream of known emission points for a given object type. This assumes that the desired type of object is registered, if necessary, by introducing national adaptations (see Figure 9 for example).</p>
<p><i>Indicator for integrated ocean management plans</i></p>	<p>The two OSPAR beaches in Svalbard are discussed in the Monitoring Group's status report for the Norwegian Sea. Otherwise, Norwegian OSPAR beach litter data</p>	<p>The Norwegian Environment Agency has no plans to use OSPAR beach litter data in the integrated ocean management plans, nor after a</p>

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	<p>is not currently used in the integrated management plans. According to the Norwegian Environment Agency, there is no intention of using these to a greater extent in the future. Rather, they will use other data sets that are more relevant to the ocean areas.</p> <p>Data from the OSPAR beaches are used within the EU as an indicator of marine litter in the Marine Strategy Framework Directive (MSFD). This directive is not part of the European Economic Area (EEA) Agreement and is therefore not applicable to Norway.</p>	<p>possible expansion of the number of beaches that are registered.</p>
<p><i>Indicator for water management regulations</i></p>	<p>Marine litter does not currently form part of the Norwegian water management regulations. Therefore, data on beach litter from the OSPAR beaches has not been used as an indicator in the water management work in Norway.</p> <p>It has been decided that plastic pollution should be included in the regional water management plans and the associated action programs from now on. However, because there are too few OSPAR beaches today, they do not constitute any great help in this work.</p>	<p>In the work on the water management regulations, each of the water bodies are assessed in relation to their chemical and ecological condition. In order for the OSPAR beach litter registrations to fully meet the need for usage in water management work, a much larger number of locations than today's will be required. As an alternative, the method may be adapted so that the registrations become representative of a region or a larger area.</p> <p>Nevertheless, OSPAR beaches will be of great help in classifying the water bodies they are placed within. An increase in the number of locations will therefore also result in increased coverage for use in the water management regulations work.</p>
<p><i>Enhancing beach litter cleanups nationally</i></p>	<p>Data from the OSPAR beaches are not currently used to prioritize cleaning efforts on national basis.</p> <p>This is probably due to the fact that there are few locations that are monitored and that the OSPAR method is not suitable for assessing the amount of marine litter within a larger area / region.</p>	<p>With a sufficiently large number of OSPAR beaches, one can get some information about differences in the amount of marine litter between large regions (for example, Northern and Southern Norway). This can be useful in prioritizing the efforts in the areas where the most litter is observed.</p> <p>Other methods may meet this need more precisely and more economically, such as "Marine Debris Action Planner" (MAP) (see discussion</p>

		<p>in the section "Other relevant methods").</p>
<p><i>Documentation of regional differences</i></p>	<p>The OSPAR method can be useful when documenting regional differences in the <u>composition</u> of beach litter. However, this is limited by a few locations nationwide.</p> <p>The OSPAR method is currently not suitable for assessing quantities of litter within a larger area / region. Today's OSPAR beaches will therefore not be suitable for assessing regional differences in <u>quantity</u>.</p>	<p>An increase in the number of locations could provide better accuracy for documenting regional differences in the <u>composition</u> of the beach litter.</p> <p>A significant increase in the number of locations could provide better accuracy for documenting regional differences in the <u>amount</u> of beach litter, if one also starts to register the weight of the litter in addition to the number. The principles on which new locations are selected will also be important. A random selection of locations will provide better statistical power, but this can cause problems in selecting locations that are suitable in other ways (cf. OSPAR's list of recommended criteria for location selection).</p> <p>Tools such as MAP (SALT) and modeling of marine litter hotspots with ocean currents (HI) can also be useful tools for assessing where monitoring is needed.</p>
<p><i>Provide data for research</i></p>	<p>The data from the OSPAR registration is currently used to a limited extent for research. This is probably due to several of the points mentioned under limitations of the OSPAR method (see separate section) - first and foremost that only number of items is recorded, which provides a poor basis for comparing quantities.</p> <p>The currently low number of locations may also have an impact, as this gives poor statistical strength and poor coverage of marine litter of Norway as a whole.</p>	<p>In Norway, if one starts to weigh the litter on the OSPAR beaches and register more locations, this will probably make the data from the OSPAR registrations more suitable for research on marine litter and thus more useful than they are today.</p>

## 3.2 Four different models for expansion of the Norwegian OSPAR beaches

Based on the results of the matrix that describes the needs (Table 5), we have defined four different options for an expansion of the OSPAR beaches.

The four different options are first described separately, and then the different effects of the four options are assessed.

### Alternative 1: No expansion

The first model is the zero alternative, that is the current situation. This involves monitoring beach litter according to the OSPAR method on five beaches in mainland Norway and two on Svalbard. Each of these beaches is registered 1-2 times a year.

Today, the registration of OSPAR beaches takes place as a kind of volunteer work, where various governmental, municipal and private organizations carry out the work within their own budgets. This is an arrangement that was agreed at the start of monitoring on these seven beaches, at a time when funds were not available for the work on marine litter. Today, work on marine litter is a higher priority, and every year money is allocated for such work through the Government budget. Even with the current model, it should be considered whether the costs associated with registering the OSPAR beaches should be refundable for those who implement it.

Regardless of the question of who will pay for the work, the cost of today's model must be made visible in the comparison. Estimated average costs multiplied by the number of beaches are therefore given in Table 6, as for the other models. It is based on the current average number of registrations per year (Figure 8) for calculation of costs.

For the established OSPAR beaches, it is important to preserve the established time series. We therefore recommend that no changes are made that may cause these time series to lapse.

### Alternative 2: Moderate expansion

An expansion with 10 new Norwegian OSPAR beaches (i.e. to a total of 17 Norwegian OSPAR beaches) is considered as a moderate expansion.

When expanding the number of OSPAR beaches, we recommend using OSPAR's guidelines for selecting locations for new beaches:

- be composed of sand or gravel and exposed to the open sea;
- be accessible to surveyors all year round;
- be accessible for ease of marine litter removal;
- be a minimum length of 100 metres and if possible over 1 km in length;
- be free of "buildings" all year round;
- Ideally not be subject to any other litter collection activities.

The criterion "be composed of sand or gravel" is not necessarily representative of beaches in Norway and reduces ecological variation in the sample. Yet, it is important to keep as many variables as possible that can influence the result constant, to give as much strength as possible to the conclusions one can draw from the data set. More uniform beaches will allow better comparison between them. In any case, the data will not be suitable for predicting representative quantities of litter along the entire Norwegian coast, without drastically increasing the number of locations and / or adapting the method (for example by introducing random selection of locations), so representativeness to substrate on typical Norwegian beaches is less relevant.

For the same reason, we recommend introducing a new criterion for selection of beaches:

- The beach should be approximately straight

This is recommended as the design of the shoreline is of importance for the amount of litter deposited on the beach over time. This is therefore a variable that should be controlled. A precaution which one might consider introducing to ensure equality between the beaches, is to introduce a relationship between the length of the beach measured along the waterline and the distance between its endpoints measured in the airline. The smaller the distance between the endpoints in relation to the length of the waterline, the greater the indentation will be allowed.

Furthermore, we recommend the new beaches to be distributed relatively evenly geographically along the coast, so that the beaches provide the best possible picture of the composition of litter along different parts of the coast. By choosing beaches that are exposed to the open sea, as the guidelines indicate, one can assume that the beaches to a lesser extent are affected by discharges from local, land-based sources<sup>11</sup> and to a greater extent exposed to long-transported litter and sea-based activity upstream of the beach. With such an expansion, including weight registration, we assume that the dataset could provide information on:

- Composition of marine litter on beaches in Norway
- Rough geographical differences in the composition of waste (for example, South versus North; sufficient number of beaches could provide information on possible latitude gradients<sup>12</sup>, but no particularly higher spatial resolution than this)
- Change of litter composition over time within a beach
- Change of litter amounts over time within a beach
- Rough geographical differences in changes in litter quantities over time (for example, South versus North; as for composition)

Altogether, the data set could give an indication of whether litter amounts in Norway are going up or down and whether measures taken against marine litter have any effect (for example: restriction on disposable plastic).

The data set will to a lesser degree be able to show:

- Absolute differences in litter amounts between regions
- Effect of local measures on marine litter

To calculate costs, we use an average of three registrations per year.

### Alternative 3: Large expansion

An expansion with 30 new Norwegian OSPAR beaches (i.e. to a total of 37 Norwegian locations) is considered a large expansion. This will bring us over the number of beaches registered in the UK, which in 2018 reported 25 beaches. 37 locations place Norway approximately in the middle of the OSPAR countries in terms of number of beaches per kilometer of coastline (Figure 6).

For the selection of new beaches, it is also recommended to follow OSPAR's guidelines and other considerations for this alternative as described for alternative 2.

In general, an expansion with 30 new Norwegian OSPAR beaches will provide information on the same factors as in alternative 2, but with higher resolution of the dataset. With a higher number of beaches, the statistical analyzes will be strengthened and it will be possible to measure changes over time with

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<sup>11</sup> Impact from nearby local sources could further weaken the OSPAR method's ability to represent an area, as they will result in significantly higher recorded amounts of waste than the "normal". Of course, if the purpose of the current OSPAR beach is to monitor such local discharges, the situation is different.

<sup>12</sup> Latitude gradients mean statistically detected differences in the amount of beach litter depending on where areas lie in a South to North gradient along the coast.

greater certainty and better ability to detect smaller differences / gradients than with fewer beaches. Nevertheless, even with such a large number of beaches, due to the general limitations of the OSPAR method, the data set will not be able to answer:

- Absolute differences in litter amounts between regions
- Effect of local measures on marine litter

To calculate costs, we use an average of three registrations per year.

### ***Geographical location of locations in clusters***

To be able to perform any kind of statistics, a certain sample size is required. With 17 scattered locations along the coast (alternative 2), it will be "impossible"<sup>13</sup> to investigate the extent to which there are differences in litter quantities, composition and influx between, for example, Agder and Rogaland. If the number of beaches is increased to 37 (alternative 3), in theory there are possibilities to select beaches in scattered clusters, that is, groups of nearby localities. 37 locations allow three beaches in most of our coastal counties, or larger clusters in fewer counties (for example, 10 clusters, each consisting of 3-4 nearby beaches). With a minimum of  $n=3$  (the number of nearby locations in each cluster), there will be some replication and opportunities to investigate variation within regions, enabling a study of variation between regions / counties. However, the level of replication will be low for such an analysis, and it is unlikely that one will have enough power to detect other than relatively large differences, since we know that local variations can be significant. However, it still enables such an analysis and will significantly increase the power for latitude regressions. If one reduces the number of clusters and instead increase the number of locations within each of these, more precise analyzes will be obtained, but with a rougher distribution of regions.

It is also emphasized that this alone will not be able to provide a reliable assessment of absolute amounts of beach litter in these regions as it only covers certain types of locations, which most likely nor will be representative of many parts of the country.

With this option, one can use the same local coordinator and cleaning crew for all locations in the same cluster, thus reducing the need for training, number of crews and inequalities in the practical use of the OSPAR method, which also reduces the workload of the national coordinator. One can also consider whether the same registration team can serve more than one cluster.

### **Alternative 4: Establishment of a complete monitoring program**

Monitoring using the OSPAR method gives a description of how the composition of litter changes over time. If one wishes to monitor quantities of marine litter and document the effect of measures, we recommend establishing a monitoring program in which several methods are combined to give a more complete picture of the development of beach litter over time. Currently, a rapid method development within monitoring of marine litter is taking place and we recommend that, after careful consideration, new methods be included if they contribute substantial new knowledge.

#### **Amounts**

Amounts can either be measured in terms of total amount of beach litter, that is, the amount of litter that exists on beaches at any given time, or in annual supply. Both of these goals for amounts are important for understanding the extent of littering and how it develops.

#### ***Total amount of beach litter***

The MAP protocol has the potential to monitor the total amount of beach litter and is as far as we know, the only existing method that can generate representative data. Depending on the geographical

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<sup>13</sup> It will be possible to carry out a regression with latitude as an independent variable. This may indicate whether there are latitude gradients in the amount, composition and supply of litter to this type of beaches along our coast, but a low number of beaches will provide low strength in the tests.

resolution you want, you have to design a program that is adapted to this. For example, it is conceivable that, associated with each OSPAR beach, litter monitoring in a larger geographical area around the beach is monitored using the MAP method.

The MAP protocol is well established, but there still remains some analysis work and thorough reflections on how it can be used in a monitoring context to be done. SALT and Keep Norway Beautiful are currently working on a large project, "KVANTESPRANG", which is financed through the Norwegian Handelens miljøfond. Through this project, the total amount of beach waste in Oslo, Agder, Møre and Romsdal and Troms and Finnmark will be mapped. The project will provide a lot of data and will form the basis for designing a solid monitoring program for total amount of beach litter. If one is interested in changes over, for example, a ten-year period, MAP can be implemented in the same area at intervals of five or ten years. In this way, it will be possible to monitor changes over a relatively long-time scale in a cost-effective way.

### *Trends in annual supply*

The OSPAR method is well suited for this purpose. It provides data that over time can describe changes in the supply of new beach litter. As described under Alternatives 2 and 3, the strength of the statistical analyzes will increase with the increased number of beaches. It is recommended that the collected litter is weighed, minimum as a weight of total litter collected.

A supplement to the OSPAR method may be Keep Norway Beautiful's project "Adopt a beach" (see description under "Other relevant methods" above).

### **Composition**

OSPAR data, reinforced by data collected in connection with voluntary cleaning actions or "Adopt a beach", will provide a good basis for monitoring the composition of marine litter.

### **Sources**

The project that is best suited to capture sources of beach litter is the method "Beach litter deep dive", developed by SALT (see description under "Other relevant methods" above).

### **Measures surveillance**

#### *Indicators for implemented measures*

There is a need to be able to demonstrate the effect of measures being implemented in Norway. One relevant example is the introduction of the EU Directive on the reduction of the impact of certain plastic products, which prohibits the use of certain items of plastic. In some cases, the OSPAR method will be suitable for this, given that there are OSPAR IDs for the relevant items. In other cases, it may be appropriate to design designated surveillance programs or introduce new ID codes into OSPAR to ensure that relevant items are registered - if necessary, by splitting existing OSPAR IDs into several categories nationally.

Registration of plastic types using NIR cameras (used by NIVA, Mepex and Keep Norway Beautiful) may have the potential to monitor the effect of measures against specific types of plastic.

#### *Monitoring the effect of local measures*

For monitoring local measures, locations can be placed downstream of the pollution sources and monitored using the OSPAR method. If desired, the registration of these locations can be adapted to the need by limiting which items are registered, or one can use these locations to reinforce the general monitoring of trends in annual supply and composition by performing full registration according to the OSPAR method.

## New methods

There is a great deal of activity in the development of new methods for mapping and monitoring beach litter. We refer here to the section "Other relevant methods" above. In particular, the use of satellite data or drones for data collection is mentioned, as well as the use of NIR cameras for detection of material / plastic types.

Another interesting method which is under development in SALT, is to look at age composition and nationality for bottles and cans. This may prove to be a method that in short term can contribute to answers as to whether litter respectively from Norway and other countries increase or decrease over time.

## Summary of effects of the four alternative models

Scope and effects of the four alternatives are summarized in Table 6 below.

**Table 6. Description of effects of various alternatives for expansion.**

Alternative	Number of beaches and cleanup frequency	Geographical location of beaches	What needs will this alternative cover?	Cost (rounded to the nearest 1 000 Norwegian kroner (NOK))
<i>1: No expansion</i>	7 beaches 1-2 times a year	Maintains today's location	See Table 5: Today's OSPAR beaches	NOK 415 000,-
<i>2: Moderate expansion</i>	10 new beaches 2-4 times a year	Equally distributed along the coast	See Table 5: Expansion of OSPAR beaches	NOK 2 341 000,-
<i>3: Large expansion</i>	30 new beaches 2-4 times a year	10 clusters equally distributed along the coast, with 3-4 locations relatively close to each other in each cluster.	See Table 5: Expansion of OSPAR beaches.  Will provide higher accuracy in analyzes than in alternative 2.	NOK 5 095 000,-
<i>4: Establishment of a complete monitoring program</i>	20 OSPAR beaches  Quantitative methods in combination with models.  Specific indicators to evaluate measures	OSPAR beaches equally distributed along the coast.  Mapping total amount and sources in several places along the coast depending on the desire for geographical resolution.	Alternative 4 has been put together to meet all the identified needs for knowledge about beach litter.	The cost of a complete monitoring program depends on the desired resolution in relation to geography and time intervals.  We estimate that the program outlined in this report will have an annual cost of NOK 5-10 million.

### Calculation of costs

We have tried to provide a rough estimate of costs for the registration of OSPAR beaches. The price will be affected by the amount of litter and accessibility. Of today's seven beaches, it is Ytre Hvaler that takes the longest time to register. That's because the supply of litter is very large there. A lot of litter is also registered in Rekvika. These are both typical "coves with particularly high wrack loads", which collect more than the average of litter nationwide but represent a type of beaches that we still find in numbers along the coastline. It is useful to register these for information on how much litter actually can accumulate in these coves. Due to the large amount of litter, they also provide good data on the composition of types of items of the beach litter. On average, however, there are far lower amounts of beach litter on a randomly selected 100-meter-long section of a Norwegian beach than what we find here. In calculating the time scheduled in Table 7, we have therefore assumed more moderate amounts than for these two beaches.

Accessibility of crew access to pick up and transport the litter will also affect the price. Remote locations will require more working hours to transport the crew back and forth. The cost of car pickup will also in most cases be lower than when picking up with boat.

**Table 7. Budget of registration of one location, once** (all prices in NOK).

Activity	Number	Unit price	Sum
<i>Working hours for registration management (preparation, finishing work)</i>	2 hours	1 200,-	2 400,-
<i>Working hours for actual cleaning / registration</i>	3x10 hours	1 200,-	36 000,-
<i>Costs of transport of crew</i>	3 persons	500,-	1 500,-
<i>Costs of transporting the litter</i>	1	4 000,-	4 000,-
<i>Costs for disposing of the litter</i>	1	2 000,-	2 000,-
<b>SUM</b>			<b>NOK 45 900,-</b>

The calculations are based on the use of a professional, paid crew. When using volunteers for parts of the work, the cost can go down significantly, but more volunteers are often needed to do the same work as a professional crew. Also, the accuracy will be reduced when using volunteers. The OSPAR method is more comprehensive than the methods used in voluntary cleaning operations, and in order to provide reliable data, high accuracy is required. Errors in registration, such as items being registered under incorrect OSPAR ID, may have consequences for future measures and research based on the use of the data. It is time consuming to gain knowledge of what different items should be registered as, and also to be able to recognize fragments of items. We would therefore recommend that sufficient funds are prioritized in order to use professional crews for registration.

### National coordination

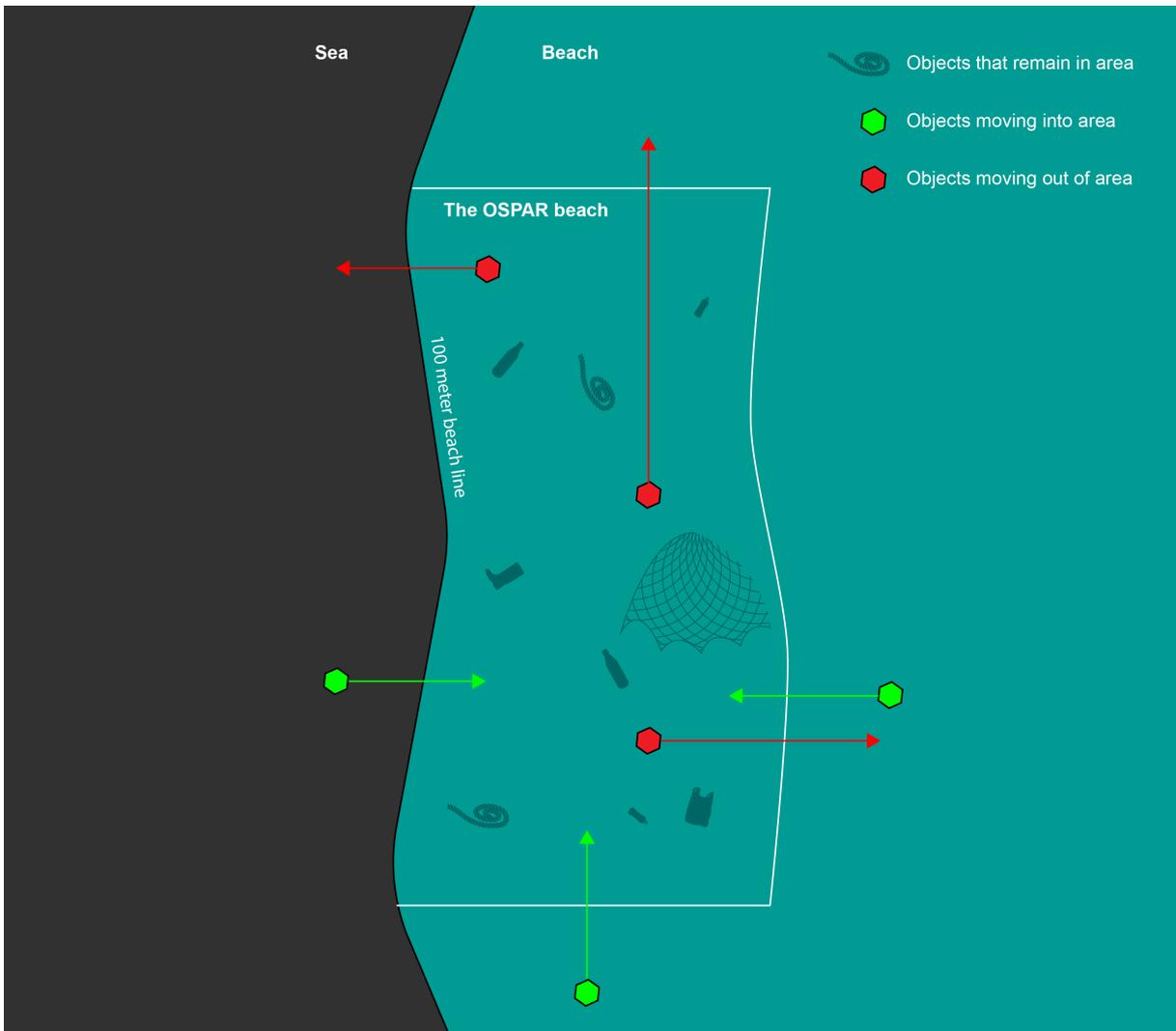
Time consumption for national coordination of beaches will also be affected by the number of beaches. Especially if an increase in the number of beaches also involves an increase of local coordinators, which it probably will. Following up on these will take more time for the national coordinator. However, this cost has not been taken into account in Tables 6 and 7.

## 3.3 Frequency of registrations

The OSPAR method describes four registrations per beach per year. In Norway, the frequency varies between one and two registrations per year - partly because some of the locations are frozen or obligated to traffic restrictions parts of the year and partly because of balancing resource use.

**The number of registrations per year is significant**

Normally, marine litter will float ashore on beaches and be transported away by wind, waves and ocean currents - either at sea, along the beach or towards land (Figure 10). It is therefore not arbitrary how many registrations are made per year. In the OSPAR method, the litter is removed during registration. In addition to preventing the same litter being registered multiple times a year, this prevents that a portion of the litter already registered is being transported at sea again or moving outside the 100-meter area registered (red items in Figure 10), as it would normally do if it was left. If the areas around the OSPAR beach is not cleaned at the same time, the amount of litter entering the beach (green items in Figure 10) between registrations will not be affected. If you only register once a year, the red items in the figure will not be included. The more often you register, the more of the red items in the figure will be included in the total for that year. This means that the total amount of marine litter that is registered within a year must therefore be expected to increase with increasing number of registrations. This makes it difficult to compare numbers before any change occurs, with new numbers being registered after a change of frequency. If you change the frequency of registration and cleaning of an established beach, this could break the time series you have previously worked out.



**Figure 10. Sketch showing the movement of items relative to the area indicating the OSPAR beach.**  
(Illustration: SALT)

### **Norway's unique conditions**

Particularly two conditions make it difficult to carry out registrations of beach litter more often than 2, or a maximum of 3 times, per year in many places in Norway. At Svalbard, it is difficult to conduct more than one annual registration per beach.

#### ***Winter***

Compared to OSPAR member states in Southern Europe, Norway has major challenges when registering beach litter in winter. The OSPAR method, and all other methods of registering beach litter, assume that one has physical access to the litter to be registered. This is rare in winter in Norway, as the litter may be located underneath a layer of snow or ice above the zone that is directly covered by sea at high tide. Winter weather also presents logistical challenges for those who are going to do the registration. These problems generally increase the farther north in Norway one gets, but even areas as far south as Oslo may have problems in the month of October / November and until March / April. Even though it may be possible to find appropriate times during this time of the year when a given location is free of snow and ice, it can be difficult to maintain approximately the same date of registration each year.

#### ***Traffic restrictions***

Locations positioned within protected areas makes third party litter cleanups less likely, and it is easier to defend using SNO inspectors to work within these areas, as cleaning marine litter is an activity they regularly do here.

At the same time this entails that for many of today's OSPAR beaches there are traffic restrictions due to wildlife in parts of the year. Regardless of regulations on traffic restrictions within specific areas, it is generally not recommended to schedule activities at a time of the year which leads to a disturbance of seabirds during the breeding season.

### **Evaluation across practices in other countries**

The average number of registrations per beach per year in Norway is 1.29. This is far lower than the four recommended annual registrations per beach, which countries farther South in Europe to a large extent follow.

However, Norway is approximately at the same level as other countries within Region I - Arctic Waters (Figure 8). Still, Iceland is closer to 2 registrations a year.

## 4. ANSWERS TO KEY QUESTIONS

In this concluding chapter, we answer the three key questions asked by the client in the assignment. However, we would like to inform that Chapter 3 also contains information on identified needs for collected data and conclusions on how different models will affect these needs.

### 4.1 How many OSPAR beaches should Norway have?

It is difficult to answer this question specifically. The number of beaches depends on which research questions you want answered and the ambitions of Norway on how thoroughly one wants to map marine litter.

OSPAR Region I – Arctic Waters is the region in OSPAR with the largest sea area and longest coastline. The need for beaches included in the beach litter monitoring network is therefore high in this area, in order to assess the condition with some degree of security. The intention to cover the Norwegian part of Region I indicates that the number of locations should be raised to the level described in alternative 3, i.e. an increase of 30 new to a total of around 37 locations.

No specific statistical calculations have been made on how many beaches are needed to achieve a certain statistical strength in mapping beach litter in different regions. A pre-study with randomly selected locations could say something about the amount of variation between beaches, and thus be used for a strength analysis that can provide knowledge about the number of beaches needed in each country / region. But this is beyond the scope of this report. However, it is generally true that a higher number of registrations leads to a greater degree of certainty in the estimates of quantities. Yet, limitations in the method itself make it difficult to say anything about a larger area or region based on individual beaches. Therefore, without an adaptation, the OSPAR method alone will not provide all the answers needed to meet the needs identified during the work on the report. Arranging locations in clusters, as described for alternative 3, will allow a rough comparison of the quantities and composition of beach litter between the different regions which the clusters are placed into.

Alternative 4 is the option that best covers the needs for national beach litter monitoring. The need for the number of OSPAR beaches seen from a purely national point of view is lower for this option, but it includes some collection of data on beach litter using other methods.

### 4.2 What considerations and criteria should be used in selection of any new Norwegian OSPAR beaches?

When analyzing collected data on beach litter, it gives higher statistical strength if one keeps variables that you can control as constant as possible between the different locations. A large variation of, for example, substrate or shape between the beaches, to cover the need for the beaches to be representative of the whole of Norway, will therefore require a larger number of beaches in order to provide the same strength in the analyzes. It is also easier and more accurate to register on a sandy or gravel beach than on a beach consisting of rocks. The selection of new beaches should therefore follow OSPAR's guidelines. One could also consider adding as a new criterion that the beach should have an approximate straight shape. Reference is also made to the description of alternative 2 in the previous chapter.

For a few locations, one can deviate somewhat from the guidelines, if special considerations indicate so. An example might be the need to monitor beach litter from a specific local source, where optimal location to capture waste originating from this source may conflict with OSPAR's recommended guidelines.

It may be considered whether new OSPAR locations should be placed in clusters, which in turn are evenly distributed along the coast of Norway (alternative 3). This could provide better statistical power for calculating quantities of beach litter using a smaller number of locations than by an equal distribution of individual locations along the entire coast, which would allow for a rough comparison of the quantities and composition of beach litter between the different regions that the clusters are placed in.

If one prefers a more detailed monitoring of beach litter, with the possibility of estimating quantities and sources more accurately, the option that includes a comprehensive monitoring program (alternative 4) is recommended.

### 4.3 How often should beaches be registered?

An individual assessment should be made of how many times it is possible to register a given location per year.

#### *New locations*

For new locations, OSPAR's recommended frequency of four annual registrations should be followed if possible. If this is not feasible, one should try to get as close to this as possible.

The fact is that in Norway, for natural reasons in several areas, we are limited to two registrations per year. This affects the strength of the statistical tests used to calculate changes over time. As mentioned under limitations of the OSPAR method, for the calculation of total amount of litter and density of the most common litter items it is required four years of registrations four times a year to establish a baseline coefficient of variance <10% (Schulz et al., 2019). Given a coefficient of variance of up to 20%, three years with four annual registrations may be enough to establish a baseline (Schulz et al., 2019). A time series of at least six years is required before data can be used to analyze trends where it is possible to detect minor changes (10% increase / decrease), provided that registrations are conducted four times a year (Schulz et al., 2019). Major changes in the total amount of litter of 30% can be detected with as few as 14 registrations (3.5 years), while 16-20 registrations (4-5 years) are needed to detect a 30% change in individual items (Schulz et al., 2019). Therefore, with fewer registrations a year there is reason to believe that we need longer time series to detect changes over time.

For this reason, the OSPAR guidelines<sup>14</sup> require a minimum of three registrations per year in order to include a beach in OSPAR's analyzes. The latter has been discussed in OSPAR several times, most recently under ICG-ML 12-15. November 2019, as this requirement will make it difficult to obtain beach litter data for Region I - Arctic Waters.

#### *Existing locations*

The reason for deviations from the OSPAR method's described registration frequency for the existing locations is stated in earlier sections of the report. For some locations, an increase in registration frequency is practically possible, but for existing locations, an increase in registration frequency will break the established time series.

Continued suitability should nevertheless be considered as described below, also for existing locations.

#### *Assessment of whether the location is suitable for (continued) registration*

For those locations where it is not possible to carry out at least three annual registrations for various reasons, the internal discussion in OSPAR should be continued if it is possible to include locations with fewer than three registrations per year in their analyzes.

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<sup>14</sup> OSPAR Agreement 2017-05: CEMP Guidelines for monitoring marine litter washed ashore and/or deposited on coastlines (beach litter), point. 3.2.5-3.2.6.

If this is not possible, attention should be given to whether continued registration of locations that do not meet this requirement is nevertheless desirable for national monitoring of beach litter. If not, one should stop registering beach litter at locations that do not provide usable data and concentrate on better suited locations. However, this may mean that OSPAR will lack coverage of the beach litter indicator in large parts of Region I - Arctic Waters, as the average number of registrations per year for all countries in Region I is below 2 (Figure 8).

# APPENDIX

## List of attachments

Sources of information

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References

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## Sources of information

### *Internal knowledge of the topic*

Project Manager Erlend Standal was employed during the period 2007 to 2016 as an advisor / senior advisor to the Norwegian Directorate for Nature Management (DN), which on 1 July 2013 was merged with the Norwegian Climate and Pollution Agency (KLIF) to form today's Norwegian Environment Agency. One of Erlend's major tasks was to follow the work on marine litter in OSPAR. He participated in the ICG-ML working group and contributed to develop the OSPAR method for registering beach litter there. Erlend was also responsible for establishing the Norwegian network of OSPAR beaches and coordinating their registration. Most of the history described in this report is taken from Erlend's memory, written sources, and in some cases elaborated upon after conversation with the others involved in this work.

SALT has, over time, also gained a great deal of general knowledge about marine litter, which this report benefits from.

### *Interviews*

The definition of Norway's need for beach litter monitoring has largely been developed from interviews with selected researchers and representatives from nature management. Those interviewed are shown in Table A-1.

**Table A-1. Interview subjects that have contributed to the definition of Norway's need for beach litter monitoring.**

<b>Name</b>	<b>Workplace</b>	<b>User group</b>
<i>Bo Eide</i>	Tromsø municipality	Coordinator – Rekvika
<i>Liv-Marit Hansen and Anne-Lise Bekken</i>	The Oslo Fjord's Outdoor Recreation Council (OF)	Coordinator – Ytre-Hvaler
<i>Arne Bretten</i>	The Norwegian Environment Agency's operative field branch (SNO)	Coordinator – Været, Sandfjordneset, Kviljo and Åpenvikbukta
<i>Håkon Larsen</i>	Governor of Svalbard	Coordinator – Brucebukta and Luftskipodden
<i>Bert van Bavel and Inger Lise Nerland Bråte</i>	NIVA	Researcher
<i>Bjørn Einar Grøsvik</i>	Norwegian Institute of Marine Research (HI)	Researcher
<i>Eivind Bastesen</i>	NORCE	Researcher
<i>Maria Pettersvik Arvnes</i>	SALT	Management – has previously worked in the Norwegian Environment Agency with responsibility for coastal waters in the water management regulations work
<i>Øystein Leiknes (correspondance only by email)</i>	Norwegian Environment Agency	Management – is working on the Norwegian integrated ocean management plans

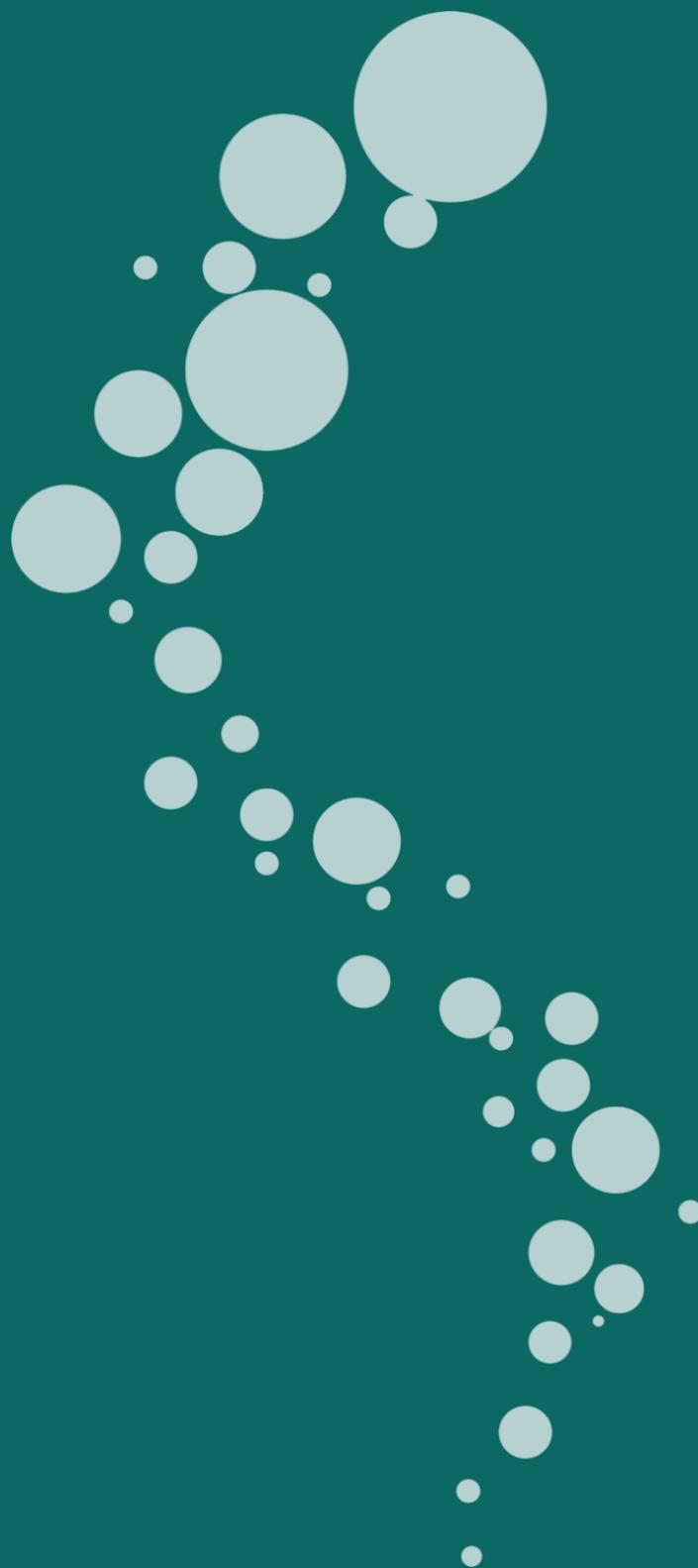
### Written sources

Written sources of information can be found in footnotes and the reference list.

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