



Nordic Council
of Ministers

MAIN REPORT

CLEAN NORDIC OCEANS

– a network to reduce marine
litter and ghost fishing

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Foreword

Clean Nordic Oceans is as a project and knowledge network that was established in early 2017. The loss of fishing gear from both Nordic fisheries and recreational fishing is an unfortunate drawback of activity at sea, which can have very unfortunate consequences. Thus, the purpose of the project was to establish a Nordic network for exchanging knowledge and experience about methods to reduce the harmful effects of ghost fishing and marine litter, and promoting increased recycling of fishing gear from both commercial and recreational fishing.

The project was established through the Nordic Council of Ministers as a Norwegian Presidency project with three years of operational funding. The target group for the project comprised all the Nordic countries. Clean Nordic Oceans has been led by Norway, with Denmark and Sweden in the management team. The project's management team comprises project manager Gjermund Langedal, Norwegian Directorate of Fisheries; Finn Larsen, Technical University of Denmark (DTU Aqua); Charlotta Stadig, Swedish Agency for Marine and Water Management; and Bård Aarbakke, Norwegian Directorate of Fisheries. Aarbakke was also responsible for the project's website and social media. The management team is responsible for the entirety of this report.

Starting with an introduction from a global and Nordic perspective, the report describes the Nordic status based on the national status of each country with regard to project initiatives. The report also describes the project and the network's working method and operations. The report concludes with the status of current knowledge and a presentation of possible measures to meet the challenges.

We would like to thank all the active contributors throughout the network and everyone who has contributed in connection with our workshops.

Summary

Marine litter is not a new challenge, but it has become increasingly visible in many parts of the world. Increased visibility has in turn led to increased focus at many different levels. What is frightening about this is that, although visibility has increased focus, there is broad consensus that the predominant proportion of marine litter is not visible but has sunk beneath the surface. Increased use of plastic products and materials with a long decomposition time is the main reason why accumulated plastic is becoming increasingly visible, together with a lack of adequate systems for handling recovered marine litter.

The Nordic region has also intensified its focus on this challenge as a consequence of the global focus on marine litter. In the Nordic region, as in many other parts of the world, both fisheries and recreational fishing account for a significant proportion of the marine litter from sea-based sources. Lost or discarded fishing gear is often comprised of plastic components, which end up in the natural environment where they may pose a risk to marine life. It is against this background that the Clean Nordic Oceans (CNO) project was established in 2017 through the Nordic Council of Ministers. Put simply, the primary function of CNO can be described as knowledge acquisition and knowledge sharing within a network of experts. Through this work, we have also obtained a relatively clear picture of the Nordic status in terms of both knowledge and measures.

The project identified significant differences between the Nordic countries, indicating that many Nordic countries need national solutions that are adapted to their fisheries, and to port and waste reception facilities. A wealth of Nordic knowledge has also been identified, though this knowledge has been characterised by strikingly little transfer of knowledge beyond national borders. However, new knowledge is continuously being acquired as a result of ongoing projects, both in the Nordic countries and around the world.

A comparison of the state of current knowledge in the Nordic countries indicates that most have little idea of the quantity and location of lost fishing gear and focus little or no effort on removing lost fishing gear. The results of the project also indicate that there is a significantly greater risk of losing passive fishing gear (e.g. gillnets, pots and fish traps) than active fishing gear (e.g. trawls, purse seines and Danish seines). In addition, there are significant differences between Nordic countries in terms of reception solutions for recovered and scrapped fishing gear. There are still major challenges relating to the reuse and recycling of fishing gear in general, and to recovered lost fishing gear in particular.

In terms of potential measures, it is clear that improving awareness and attitudes is one of the most important areas to work on, but there are also many other measures that could be implemented both at sea and on land. These are, to name just a few, measures such as amendments to regulations, secure reception facilities and the establishment of systems for reporting lost fishing gear with subsequent clean-up. Common to all measures is that they are not equally relevant to all countries, and it is therefore important for each country to identify measures that suit their respective challenges. The project, knowledge status and measures are described in more detail in the report.

Chapter 1: Introduction

The introduction of plastic and plastic products into our global community has had many positive aspects, but it has also come with a lot of negatives. One of the major challenges with plastic is when it does not follow a proper life cycle, where it is not dealt with and processed the way plastic and plastic products should be. Our greatest challenge in terms of plastic is the combination of lost or discarded plastic products and the extremely long time it takes for plastic to decompose. The ocean is one place where there should be no lost or discarded plastic. However, plastic has been littering the ocean for many decades, but it has been less visible and has consequently received little attention. Now there is so much plastic in the ocean that we can see it almost everywhere. There are no clear figures on how much plastic is visible and how much litters the seabed, but many publications suggest that over 90 per cent of the plastic in the sea is not visible but on the seabed.

Who contributes to plastic pollution in the ocean? Everyone. While not necessarily set in stone, global figures indicate that 80 per cent comes from land-based sources, while 20 per cent comes from sea-based sources. It is natural to assume that users of the ocean are also those most responsible for marine litter, but in the big picture of plastic litter in the ocean, we are virtually all contributors in one way or another – and we should all help to significantly reduce this problem. “Significantly reduce” are not randomly chosen words, but rather the phrasing used in the UN’s Sustainable Development Goals. We live in a corner of the world where these challenges are not as visible everywhere, but they are there. Who thinks about the fact that many important components of fishing gear are in fact made of plastic? The importance of fishing varies between the Nordic countries, but it is important enough that we all make a significant contribution to marine litter in the form of fishing gear from both commercial and recreational fishing. Increasingly, new knowledge is documenting the unfortunate consequences this can have on the marine environment, such as ghost fishing.

The Nordic region has enormous natural diversity, which also includes large ocean areas. We have deep seas and shallow seas, with ice and without ice – as well as varying degrees of currents, winds and waves. All of these factors are natural conditions that make it difficult to avoid the loss of fishing gear. It is important to understand that much of the fishing gear that is lost at sea is the result of unfortunate circumstances, while other losses are the result of a lack of routines and knowledge. Recent knowledge from several Nordic countries also shows that much of the marine litter found on beaches is fishery-related. This knowledge also shows that much of this debris has not simply fallen into the sea. This indicates that attitudes do not reflect the fact that the ocean is a source of food and not a garbage dump. It also shows that we do not have sufficient waste management routines for fishing gear that can end up further down the food chain with the potential to harm birds, fish and mammals, both in the ocean and on land.

Nordic co-operation has a long tradition of exchanging knowledge and working together to solve challenges. This was also the starting point when Norway initiated a Presidency project through the Nordic Council of Ministers. This initiative was given

the title "Clean Nordic Oceans". The purpose of this initiative was to establish a knowledge network and, through this network, contribute to increased knowledge in the Nordic countries with the aim of reducing losses of fishing gear and ghost fishing, as well as contributing to a solution for better reception facilities and increased reuse and recycling.

The way in which this has been organised and resolved is set out in the report.

Plastic

Plastic is a synthetic material consisting of one or more polymers and various additives. Most types of plastic are produced from petroleum. Globally, the use of plastics and plastic products has increased dramatically. A common characteristic of plastic products is their long decomposition time.

Plastic in the sea

A number of publications state that about eight million tonnes of plastic goes into the sea each year, of which around 640,000 tonnes is from fishing equipment. Plastic is an important component of virtually all fishing gear.

Chapter 2: Global and national perspectives

2.1. The global perspective

In recent years, marine litter has increased and become more visible, giving rise to much more concern and attention in national and international forums. There seems to be a broad consensus that there is a need for change. Changes can be seen primarily through marine management and people's attitudes toward the ocean. However, national and regional capabilities and willingness to change vary greatly.

Marine litter is an increasing challenge, and one that does not respect borders. Fishing gear accounts for a significant proportion of this debris, either fully intact or in pieces. This in turn can contribute to ghost fishing of fish and shellfish as well as seabirds and marine mammals. There is also evidence that debris from fishing gear on beaches contributes to the injury and death of both birds and mammals. Precisely how fishing gear contributes to ghost fishing and how long it can last depends on a number of factors. Knowledge concerning the extent to which fishing and loss of fishing gear contribute to microplastics in the sea is still limited. However, the UN Food and Agriculture Organization (FAO) has published a report entitled "Microplastic in fisheries and aquaculture" (Lusher *et al.* 2017), which mainly focuses on the absorption of plastic in the marine food chain.

Records of marine litter on Europe's beaches show that 80–85 per cent of the debris consists of plastic materials, around 50 per cent of which consists of disposable plastic products and 27 per cent of fishery-related products. These figures may well vary greatly, and in northern or arctic regions, we see that the proportion that can be related to fishing gear is higher. The United Nations Environment Program (UNEP) and the FAO estimate that 640,000 tonnes of fishing equipment fall into our seas every year. The European Union (EU) has estimated that around 20 per cent of fishing gear used every year is lost, i.e. around 11,000 tonnes per year. While there is great uncertainty associated with these estimates, they do give an indication of the extent of the challenges.



Fishery related litter is found worldwide.

Photo: Ryan Tabata/NOAA

How could this happen? The answer is complex and probably very different in the different corners of the world. The ocean has hidden much of this waste over a long period of time, but the combination of increasing litter and the use of products with a very long decomposition time has made this visible to us all. Along with the fear of the potential consequences of plastic being absorbed into the ecosystem, the visibility of marine litter and our increased knowledge of the serious challenges this presents are probably the primary reasons why the global community is beginning to react.

UN Sustainability Goal 14 addresses the sea: Conserve and sustainably use the oceans, seas and marine resources for sustainable development. Target 14.1 states: *"By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution."* The challenge of lost fishing gear has also been highlighted by the FAO's Committee on Fisheries and the United Nations Environment Programme.

The international legal framework is important. National implementation and compliance are somewhat different and, as a framework, they differ in character with regard to the degree to which they are directed at fisheries. In the context of international frameworks that address challenges that can be linked to marine litter, it would be natural to mention the following:

- UNCLOS – United Nations Convention on the Law of the Sea
 - Articles 192, 194, 207, 210 and 211
 - United Nations General Assembly (UNGA) A/RES/73/125 (2018)
- International Maritime Organization (IMO)
 - The MARPOL (IMO) Convention
 - London Convention
 - Action Plan to address marine plastic litter from ships (Res. MEPC 310 [73])
- The UN Fish Stock Agreement (UNFSA)
- The FAO Code of Conduct for responsible fisheries

The work of agreeing on a global framework that adequately balances national considerations and capabilities with what constitutes a good framework can be very challenging. However, experience shows that the interface between the framework and national implementation is at least as challenging. This is not just about capacity and will, but equally about having the knowledge needed in order to conduct the implementation and to benefit from the intentions of the regulations. With regard to fisheries, FAO and Global Ghost Gear Initiatives (GGGI) are a good tool for knowledge sharing and providing guidelines for implementation. There are also many smaller non-governmental organisations (NGOs) that do important work in this interface.

Although marine litter poses a challenge without regional and national boundaries, global frameworks also form the basis for work within many regional organisations. Work from a regional perspective is important since there are often many comparable factors and thus regional synergies of national solutions. From our part of the world and the Northern European region, it would be natural to mention the following:

- OSPAR – The Convention for the Protection of the Marine Environment of the North-East Atlantic
- Arctic Council
- North-East Atlantic Fisheries Commission
- European Union – through various organisations and directives

In the transition to a national perspective, there will be a number of smaller regional and Nordic associations.

Global law and regulation of the sea

The three most important institutions for global regulations and marine guidelines.



UN Sustainability Goals

The UN Sustainable Development Goals (SDGs) constitute the world's shared action plan with the objectives of eliminating poverty, combating inequality and halting climate change before 2030. The plan has 17 defined goals. SDG 14, deals with life below water and marine litter.



2.2. The Nordic perspective

The Nordic region has long been far ahead in terms of work with marine litter and, in recent years, has strengthened its position through increased efforts and focus. Despite this, there is no shortage of challenges and needs for solutions. A great deal of effort and funding is allocated to various actions, projects and initiatives by both volunteers and organisations. However, there are relatively large variations in provisions and types of measures between the Nordic countries. There are many excellent projects that are helping to reduce marine litter and raise awareness of the issue. A good example is the Nordic Coastal Clean-Up Day, where all the Nordic countries mobilise thousands of volunteers who help to clear marine litter from beaches and coastal areas.

Coastal clean-up is a good measure that not only removes waste, but also raises awareness of the issue of marine litter. Having clean-up days at the same sites each year also highlights the magnitude of the inflow of marine litter and that a good part of this debris comes from fishing activity. If the Nordic countries are to remain among the leading regions in the fight against marine litter, it is very important to work through active and preventive measures aimed at specific types of waste, including fishery-related waste.

Some of the first Nordic measures to combat marine litter and probably the first specifically aimed at fisheries were implemented in the early 1980s, when Norway started annual clean-up operations at sea for lost fishing gear. This work continues to this day and is probably the world's longest continuous maritime litter initiative. This annual clean-up operation is still one of the best clean-up measures for lost fishing gear, but has gradually become more efficient and is now also supplemented with other initiatives. The Nordic countries have implemented many other good measures and systems since then, but a common thread is that measures are not always easy to transfer to other countries, even within the Nordic countries. This is due to large differences despite the countries' proximity. The most obvious difference between the Nordic countries is that some of the countries are connected to the Atlantic while others are connected to the Baltic Sea. This leads to large differences

in the biological species that are being fished and the sizes of the fish stocks. In addition, there may be even greater differences in non-biological factors such as ocean depth, current and wave conditions, and bottom topography. These factors affect the fishing fleet structure, including the size of the fishing vessels, the fishing gear used, the loss rate and a number of other factors.

In addition to the variations that arise as a result of countries being linked to different marine areas, there are other major differences. Some countries are island states, while others border one or more other countries, and there are also differences in the regulations of different countries. Island states are better positioned to control their own imports and exports of goods, which is something from which Iceland, for example, has been able to benefit when it comes to plastics. They have introduced a tax on imported plastics in order to promote reuse and recycling. This tax is essentially applicable to fishing gear as well, but the Icelandic fishing industry has avoided this tax by taking on collection and recycling responsibilities.



The Nordic region is connected through different oceans.

This system can be very difficult to copy to countries that have multiple borders, have different regulations and to a large extent have fishing industries that use gear that presents challenges in terms of reuse and recycling. The regulations also result in significant differences in the scope of recreational fishing. For example, in Norway and Sweden, recreational fishing is a significant source of lost gear, while in Iceland recreational fishing is largely limited to hand-held fishing lines, which greatly reduces the challenge of recreational fishing.

Another difference that makes it challenging to directly transfer measures and laws is the substantial variation in the infrastructure of the different countries. In the Nordic countries, there are few but large fishing ports, while other countries have many, smaller fishing ports. Thus, the challenges associated with setting up good

reception facilities are very different. There are also wide variations in road construction and access to good landfills, incineration plants and recycling companies. Two extremes in this context are, on the one hand, Denmark, which has a small number of fishing ports with very well developed road networks, good access to landfills, incineration plants and recycling companies. Greenland, on the other hand, has a very limited road network and is characterised by several small ports with access to only a few landfill sites that also often drain into the sea.

The wide variation between the Nordic countries means that a similar set of measures cannot be implemented for all the Nordic countries, but that each country must look at different measures that are well suited to the challenges and opportunities of the respective country. Clean Nordic Oceans aims to help put appropriate measures in place, but there is no "one size fits all" solution. The project has also observed the disparity in how the various Nordic countries view the challenge of marine litter and loss of fishing gear. This is true at all levels, from politicians, authorities and fishermen to the public. These types of inequalities are likely to affect the willingness to take action. New systems and projects can be both expensive and unpopular.

As mentioned earlier, the Nordic countries are in the upper tier when it comes to work on fishery-related marine litter, which is reflected through the regional and national organisations and projects that work on the problem. The Nordic countries also have several national organisations and companies that prioritise a lot of time and resources on a variety of initiatives, such as measures and projects that identify sources of marine litter and look at measures for countering marine litter, solutions to increase fishing gear recovery and clean-up of lost fishing gear. The Nordic countries thus have every opportunity to remain in the upper tier, but then each country must act on the facts of marine litter and especially with regard to fishery-related litter. Naturally, various and country-specific measures can be implemented. Some possible measures are highlighted in Chapter 4.2.

2.3 National status

As previously described, the Nordic region shares many common features, but there are also significant differences. Mapping these has therefore been one of the central tasks of Clean Nordic Oceans. This is presented in the sub-chapters on commercial fishing, recreational fishing and established measures, with established measures addressing three key aspects of the issue. These central aspects are: the reporting of lost fishing gear, clean-up from the seabed, and taking in fishery-related waste and discarded fishing gear.

2.3.1 Denmark

Commercial Fishing

At the end of 2018, the Danish fishing fleet consisted of around 2,100 fishing vessels, of which almost 796 are less than 6 metres and 1,878 are less than 15 metres. Based on type of gear, the vessels are approx. 33 per cent gillnet and hook-and-line vessels, 13 per cent seine and combination vessels, about 11 per cent trawlers, while other vessels, which are primarily vessels of less than 10 metres, make up about 43 per cent of the fleet. The fishing fleet employed about 5,600 professional and part-time

fishermen in 2018. Total landings in 2018 amounted to approximately 789,000 tonnes of fish and shellfish, with a total value of about DKK 3.5 billion. The five most important species based on landing value are herring, sprat, plaice, cod and sandeel.



A danish fishing vessel.

Photo: Anne-Mette Kroner

Recreational fishing

There are 200,000–300,000 sport and recreational fishermen in Denmark who obtain fishing licenses annually. Sport fishermen can only use light hand-held gear such as fishing rods, jigs and harpoons. Recreational fishermen can use line, gillnets, fish traps and pots. Individual fishermen may only use six pieces of gear, of which no more than three pieces can be gillnets. Rules for sport and recreational fishermen can be found on Fiskepleje.dk. Recreational fishermen's gear must be marked so that the owner can be identified. Fiskerikontrol is the body responsible for ensuring compliance with regulations and is authorised to remove any incorrectly marked gear.

Established measures

Reporting: For commercial fishermen, the rules are that they must try to salvage any lost gear. In Denmark, most fishermen succeed in this, but if this is not possible, according to EC Regulation No. 1224/2009, Article 48, lost gear must be reported to the relevant authority within 24 hours, which in Denmark is the Danish Fisheries Authority's Fisheries Monitoring Centre. It is important that lost gear is reported, as the reports can be used as a starting point for detecting the lost gear.

Clean-up: There is no systematic clean-up of lost fishing gear in Danish waters. In 2019, a project was started to assess the extent of ghost nets in Danish waters. The project will also consider methods and costs for cleaning up lost fishing gear.

Reception facilities: Danish fishermen who pick up ghost gear and other marine litter in their own gear during fishing operations will usually bring this ashore. Part of the reason for this is probably that lost ghost gear and other marine litter can be

delivered to Danish fishing ports free of charge. This also applies to gear of unknown origin.

2.3.2 Finland

Commercial Fishing

In 2016, the Finnish fishing fleet consisted of around 3,000 fishing boats. A majority of the fleet is less than 6 metres and is primarily used for gillnet fishing and other pot fishery. The number of these boats has fallen significantly over the last twenty years. The same trend can be seen among medium-sized boats (12 to 24 m), with the number having been reduced by 75 per cent in 20 years. In the 1980s, there were 4,700 commercial fishermen in Finland, while in 2016 there were only about 2,000 fishermen left who earned more than 30 per cent of their annual income from fisheries.

About 85,000 tonnes of herring were fished annually in the 1980s, but the catch fell dramatically in the early 1990s. This is partly due to the closure of fur farms, which used herring as feed. In recent years, there has been a slight increase in catch volume due to changes in the trawler fleet.

As a consequence of the increase in trawler activity, annual catches by commercial fisheries have increased by more than 50 per cent since the 1980s. In 2016, more than 90 per cent of the total catch (157,300 tonnes annually) was herring and sprat. The third most fished species was sea bass with a catch of 700 tonnes per year. The commercial catches of sparling and bream respectively were 670 and 500 tonnes annually.



A finnish fishing vessel.

Photo: Pekka Kotilainen

Recreational fishing

The number of recreational fishermen in Finland has remained steady over the last decade at around 300,000. In 2016, 58 per cent of these fished with hook and line and 51 per cent fished with spinners, while around 35 per cent engaged in jig fishing. Less than one in four (23 per cent) of recreational fishermen fished with gillnets. Compared to other Nordic countries, much of this fishing takes place in fresh water.

Finnish fishing regulations stipulate that fishing with hooks, lines, ice fishing and herring rigs is free of charge. Rod fishing is free for fishermen under the age of 18 and over the age of 64, while everyone else must pay a "fisheries management fee" in order to be legally entitled to fish with a fishing rod (does not apply in the Åland Islands, Lapland and in some special regions). Other types of fishing, i.e. gillnets,

lines, pots, traps, etc., always require payment of the "fishing management fee" and permission from the landowner.

Since 2000, recreational catches have fallen from 11,600 to 7,500 tonnes. Perch, pike, bream and some whitefish species were the most common species in 2016, and catches of perch were just over 2,000 tonnes.

Established measures

Reporting: As an EU member, EU Regulation No. 1224/2009, Article 48, on the reporting of lost gear applies. However, there is no system for reporting lost fishing gear in Finland. The hope is that a reporting procedure for commercial fishing will be established in the future. There is not only a need for such a system for sea fishing, but also for fishing activity in fresh water, where fishing also takes place.

Clean-up : There is no systematic clean-up in Finnish waters. The extent of ghost fishing in Finland is unknown, and only occasional information has been received from Finnish diving clubs and associations. Diving clubs have described lost gillnets catching fish and marine mammals around wrecks and other objects on the seabed. It is believed that sedimentation of lost gear takes place quickly in the Finnish sea areas, but there is no evidence to prove this.

In 2019, however, a project under the auspices of the Finnish Environment Institute (SYKE) was completed in collaboration with the Finnish Fishermen's Association (SAKL), which involved mapping and cleaning up lost fishing gear in Finland. Little gear was found on the seabed and the findings showed only a small degree of ghost fishing.

Reception facilities: In Finland, there are six important fishing ports that are defined as larger ports by Finnish scale. In addition, there are around 40 smaller ports along the coast. The ports and fisheries authorities, together with fishermen, organise occasional campaigns to clean up the fishing ports. Nevertheless, there is no regular or systematic collection of recovered fishing equipment.

2.3.3 The Faroe Islands

Commercial Fishing

In 2019, the Faroese fishing fleet consisted of a total of 654 fishing vessels. This fleet comprises 62 trawler and purse seine vessels, 7 gillnet vessels, 13 smaller pot fishing vessels and 572 other vessels (of which 524 were under 15 gross tonnes) that fish with lines, hand lines and other gear. In 2019, fish and shellfish were landed to a value of around DKK 3.3 billion. The main species fished on the seafloor are cod, haddock and saithe, and in pelagic fishing the most important species are mackerel, herring and blue whiting.



A local harbour at the Faroe Island.

Photo: Meinhard Gardlykke

Recreational fishing

All residents of the Faroe Islands are free to fish for their own consumption and no licenses are required. However, non-residents must obtain recreational fishing permits.

Established measures

Reporting: New fisheries legislation contains changes that affect all fishing around the Faroe Islands, including for foreign vessels in Faroese waters. These changes state that if a fishing vessel loses gear and is unable to retrieve the gear, the skipper has a duty to report this to the authorities. In the report, the skipper must state the position, date, quantity and type of gear that was lost.

Some vessels likely lose gear, but technology and developments in gear retrieval have resulted in the owner usually recovering the lost gear. This is done using AIS, VMS and sensors. In 2019, there were some cases where vessels lost trawls, but in all these cases the inspection vessels succeeded in dredging up the trawls.

Clean-up: There is no systematic clean-up of lost gear in the Faroe Islands, but in 2020, the Faroe Islands plan to allocate time for dredging in defined areas where there has been a lot of fishing with gillnets in deep water.

Reception facilities: Most ports have set up containers for receiving fishing equipment. Delivery of recovered gear from unknown owners is free of charge.

2.3.4 Greenland

Commercial Fishing

In Greenland, fishing is divided into two fleet segments: the deep-sea fishing fleet and the coastal fishing fleet. The ocean-going fleet is small, while the coastal fishing fleet is larger and is divided into two different vessel groups: vessels up to 6 metres (dinghies) and vessels from 6 metres up to 120 gross tonnes. Around 750 vessels belong to the coastal fleet. Of these, 257 vessels were registered as active fishing vessels in 2018. In addition, 5,372 licenses were issued to smaller vessels (dinghies) and dog team licenses in 2018 for fishing for halibut, cod, wolf fish and salmon.

The coastal fishing fleet in Greenland primarily fishes for shrimp, halibut, cod, crab, wolf fish and, to a lesser extent, salmon. In addition, there are some bycatches of rabbit fish and redfish that are sold along with the above-mentioned fish species. In 2018, the above-mentioned 257 active vessels had catches of 55,339 tonnes of fish

worth a total of DKK 611.3 million. In addition, smaller vessels (dinghies), snowmobiles and sledges fished a total of 38,642 tonnes of fish that was sold for a value of DKK 482.5 million. The value of fish caught by the ocean-going fleet is not included in these figures.



A greenlandic fishing ground.

Photo: Grønlands Fiskeri Licens Kontrol

Recreational fishing

If you are a resident and have an address in Greenland, recreational fishing of all types of fish is permitted without a license. Salmon is an exception to this rule and requires a license. Recreational fishing in Greenland is mainly for trout, salmon, redfish, halibut, wolf fish and cod. If you want to sell your catch as a recreational angler, you must have a license. However, recreational fishermen are currently only permitted to sell cod.

Established measures

Reporting: In 2017, a decision was made to introduce a number of provisions requiring fishermen to try to retrieve lost fishing equipment. If this is not possible, the fishermen must notify their home municipality and the Greenland Fisheries License Control (GFLK) within 24 hours. This is in accordance with sections 19 and 20 of the Greenland Home Executive Order No. 4 of 30 March 2017 on technical conservation measures in the fishing industry for lost and abandoned fishing gear. Despite this initiative, GFLK has stated that reporting of lost fishing gear does not function optimally. The reporting system is based on a paper form, but the goal is to move to an electronic solution in the near future.

Clean-up: The Ministry of Nature and the Environment has been commissioned to draw up an action plan for cleaning up ghost gear and gear remaining in catch areas for the whole of Greenland. The consultancy firm COWI carries out the work on order from the Department of Nature and the Environment. The work includes interviews, data collection, seabed mapping and GIS analysis aimed at identifying hotspots for fishing gear. In addition, an economic calculation and a socio-economic analysis have been prepared for the clean-up of ghost gear at the designated hotspots.

In 2019, the Greenland Environment Fund allocated funds for a number of projects, including for cleaning up fishing equipment.

2.3.5 Iceland

Commercial Fishing

Iceland is a small island nation where fishing is an important industry for the country. Around 1,600 commercial fishing vessels land approximately 1.2 million tonnes of fishery-related seafood annually. Commercial fishing consists of various types of trawl fishing, pot fishing, line fishing, seine fishing, jigging and gillnet fishing. The most common bottom species is cod, which is caught using bottom trawling, lines, gillnets, jigs and seines. The most common pelagic species are smelt, mackerel, herring and blue whiting, which account for around 59 per cent of total landed catches by weight. These species are primarily fished using pelagic trawls and purse seines.



Icelandic vessel in rough sea.

Photo: Svanhildur Egilsdottir

Recreational fishing

There are low levels of recreational fishing in Iceland, consisting primarily of hook-and-line fishing. Therefore, it is assumed to have very little impact on marine litter in Iceland and in the Nordic countries.

Established measures

Reporting: In Iceland, it is illegal to leave fishing gear permanently in the sea, including lost gear. If it is not possible to recover lost gear, the loss must be reported to the authorities. Nevertheless, there is little feedback on lost fishing gear, which indicates that there is little reporting of lost fishing gear rather than that no gear is lost. This is probably related to the fact that existing regulations can be interpreted in a way that the fishing vessel will be held financially responsible for the recovery and clean-up of the lost gear.

Clean-up: There is no systematic clean-up of lost fishing gear in Iceland. Parts of the deep-sea fishing fleet also participate in the project "fishing for litter", where the fishing vessels themselves bring ashore fishery-related debris that is collected during fishing operations.

Reception facilities: Iceland has an established system for receiving and disposing of scrapped fishing gear. This is a seemingly well-functioning system where the fishermen themselves have taken the initiative to implement a system that ensures that fishing gear is received and processed prior to sending the parts to recycling. Furthermore, they are required to report to the authorities, and they state that approximately 90 per cent of scrapped fishing gear is recycled. No other Nordic

country can show such high figures.

One of the mechanisms behind this system is that the Icelandic authorities have good control over materials, including plastic, entering and leaving the country. This has led to fishing equipment being covered by a law that essentially places a recycling fee on fishing gear (a form of deposit). There is an exception in the law for companies that handle the collection and recycling of the material themselves, and this has been done by the fishermen. More information about this system is available on CNO's website (<http://cnogear.org/news/english/recycling-of-fishing-gear-in-iceland>).

2.3.6 Norway

Commercial Fishing

Norway is a nation with a long coastline and a lot of fishing activity, and with about 6,000 commercial vessels. Of these, around 5,550 vessels are less than 15 metres, around 220 vessels are between 15 and 28 metres and around 240 vessels are over 28 metres. In 2019, the Norwegian fishing fleet landed approximately 2.5 million tonnes of wild-caught seafood with a landing value of around NOK 21 billion. The fishing fleet uses most gear such as gillnets, pots, lines, trawls, purse seines, Danish seines and hand lines / trolling lines, as well as some other gear. The deep-sea fishing fleet primarily uses trawls and purse seines. The coastal fishing fleet primarily uses gillnets, lines and pots. The latter also account for the bulk of lost fishing gear.

In Norway, it is prohibited to dump fishing gear into the sea. Furthermore, there is a requirement that fishing gear is tended and it is therefore prohibited to leave fishing gear in the sea. In large parts of fishing activities using gillnets, lines and pots, the Coast Guard Central must be notified when gear is put into the sea and when it is taken on board. Information about fishing gear in the sea is updated every 15 minutes and is visualised by means of mapping tools on a dedicated website (<https://www.barentswatch.no/fiskinfo/>).



A Norwegian fishing vessel during coastal fishing.

Photo: The Norwegian Directorate of Fisheries

Recreational fishing

Recreational fishing is very popular in Norway. This is part of the public right to harvest natural resources for personal consumption. The use of hand lines, pots, gillnets, fish traps and lines is permitted, but with a limited amount of gear. Experience has shown that knowledge of the use of fishing gear in this group is significantly lower than for active fishermen. With regard to the causes of lost gear,

accumulated knowledge shows that many losses can be attributed precisely to lack of knowledge. This results in the loss of a disproportionate amount of fishing gear from recreational fishing. Surveys conducted by the Institute of Marine Research show that this mainly comprises fishing for shellfish with pots. People are required to register in order to participate in lobster pot fishing, and in recent years, the number has varied between 23,000 and 33,000. A voluntary reporting solution has contributed to the emergence of a significant number of actors engaged in clean-up activities in the coastal zone, both with and without public support.

Established measures

Reporting: Regulations state that fishermen must try to retrieve any fishing gear they may lose. If they are unable to retrieve their gear, the loss must be reported to the Coast Guard Central. This works well, although there is no reason to believe that all losses are reported. Recreational fishermen are not required to report lost fishing gear, but a significant number of such losses are reported through a voluntary app developed by the Norwegian fishing authorities (App store / Google play – "fritidsfiske").

Clean-up: Annual clean-ups have been held since the beginning of the 1980s. Since that time, around 650 km of gillnets and considerable amounts of other lost gear have been cleaned up. Continuous reporting throughout the year forms the basis for effective clean-up of the fishing grounds. Between 70 and 80 per cent of reported losses are recovered. For 2018 and 2019, significant quantities of recovered fishing gear were returned to the owner. Parts of the deep-sea fishing fleet also participate in the project "fishing for litter", with the fishing vessels themselves bringing ashore fishery-related debris that is collected during fishing operations.

Reception facilities: In Norway, there are a great many fishing ports, with varying and sometimes little capacity for receiving scrapped and broken fishing gear. However, a private operator handles a significant portion that is sent to recycling, though this covers only a limited number of ports. Work is underway on a national system for fishermen to deliver scrapped fishing gear in all ports. Work is also being done on some sporadic solutions for national recycling and reuse, but this is on a small scale.

2.3.7 Sweden

Commercial Fishing

In 2019, the Swedish commercial fishing fleet consisted of 1,163 licensed fishing vessels. The economically most important species for the Swedish fishing industry in order of landing value are herring, Norway lobster, shrimp, crustaceans and cod. The types of equipment used by professional fishermen are: trawls, Danish seines, hooks, gillnets, cages, pots and purse seines.

Professional fishermen who lose their equipment and are unable to salvage it must report the loss in accordance with Article 48 of EU Regulation (1224/2009). The report must be sent within 24 hours of the retrieval attempt. In order to prevent the fishing gear from being picked up by parties other than owner, there are rules for marking equipment. This marking provides an opportunity to find the owner of the gear if it is lost or left in the sea.



Swedish fishing vessels in harbour.

Photo: Natalie Greppi

Recreational fishing

In Sweden, there is great interest in recreational fishing. A survey shows that 1.4 million Swedes engage in recreational fishing every year. The following gear is used: gillnets, lines, fish traps, pots and handheld fishing gear. The Swedish Agency for Marine and Water Management has national responsibility for fish stocks and fisheries legislation. For some species, there are minimum sizes, preservation periods and, in special areas, species are protected. There are a number of rules on how fishing equipment used in the sea should be marked. These rules are available at <http://www.svenskafiskeregler.se>. There are also rules regulating which types of gear can be used in the different areas.

In order to reduce the total fishing pressure on endangered stocks, the amount of fishing gear or catch quantities may also be limited. The protected areas and the rules that apply to them can also be found on the map at <http://www.svenskafiskeregler.se>.

Established measures

Reporting: Professional fishermen who lose their equipment and are unable to salvage it must report the loss in accordance with Article 48 of EU Regulation (1224/2009). In Sweden, the loss is reported to the Fisheries Monitoring Centre (FMC). There is no requirement for loss-reporting for recreational fishing. The Swedish Agency for Marine and Water Management is working to develop a reporting tool called Ghost Guard, that allows recreational fishermen to report lost fishing equipment on a voluntary basis, as well as reporting whether they have found and recovered lost fishing equipment.

Clean-up: In Sweden, measures such as dredging and diving efforts are being used, mainly by fishermen, diving associations and other voluntary stakeholders, to clean the seabed of lost fishing gear. They can apply for state funding for this work and grants from the European Maritime and Fisheries Fund for the collection of lost fishing gear and marine litter in general. There is no overall national, continuously organised recovery of lost fishing gear.

Reception facilities: A fishing port is a port that is a home port for fishing vessels or that provides services to fishing vessels. Fishing ports in Sweden are responsible for having reception systems and receiving waste generated by fishing vessels and other

cargo waste that the vessels need to offload. Waste generated by fishing vessels is the waste that is produced during operation of the vessel. It may include household waste, septic waste and scrapped fishing equipment, and it also includes waste that fishing boats take on board as bycatch during fishing operations. This can be all kinds of waste, such as scrapped gear, ropes, buoys, etc. On the west coast of Sweden, in the municipality of Sotenäs, there is also a new recycling centre that processes and recycles abandoned and lost fishing gear.

Chapter 3: Method and operation

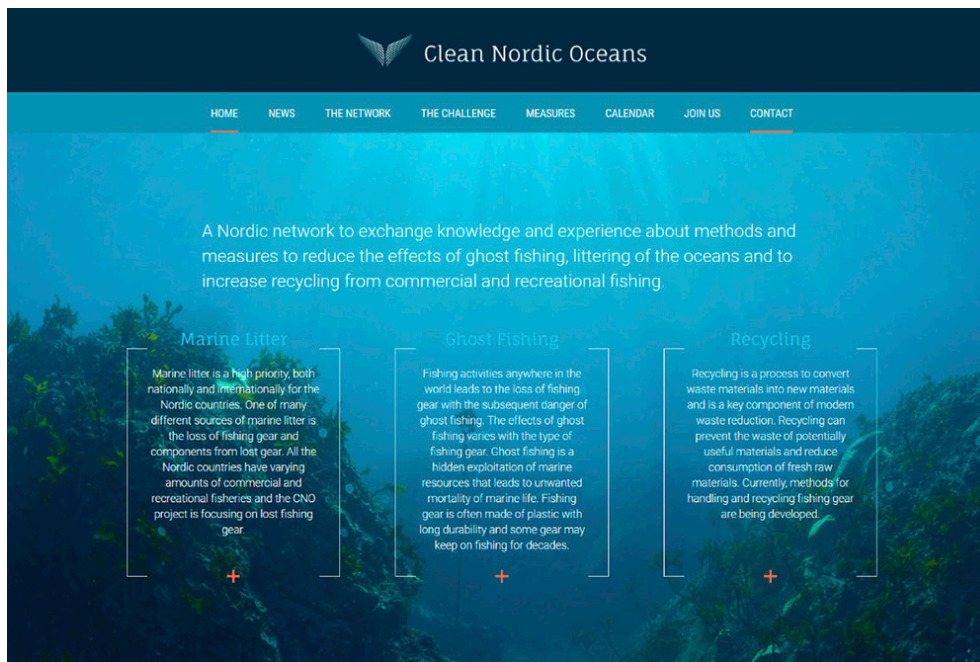
Clean Nordic Oceans was established as a Nordic network for exchanging knowledge and experience about methods for reducing the harmful effects of ghost fishing and marine litter, and for promoting increased recycling of fishing gear from both commercial and recreational fishing. This chapter describes the method for achieving the project's intentions. There is also a description of how this was resolved by means of ongoing operations. The phases can mainly be divided into the following parts:

- Start-up
- Knowledge acquisition and knowledge sharing
- Recommendations and key findings

Establishing the Clean Nordic Oceans brand name and project organisation was fundamental and necessary before initiating work in the network. There was also a process to identify and clarify the status of Nordic knowledge and measures. Knowledge acquisition and knowledge sharing represent the mainstay of day-to-day operations, in addition to sub-products during the project period. The final report and policy brief with main findings and recommendations are the final product.

3.1 Establishing the network and brand name

There are a great many stakeholders and organisations active in the field of marine litter. Creating a brand name makes it easier to identify our operation, while also differentiating it from other players. That is why Clean Nordic Oceans was established as a brand name with an associated logo in the initial phase of the project. A website for the project was also quickly established (<http://www.cnogear.org>). The brand name and website served as the platform for starting work on building a network around the organisation. After the first two measures were implemented in 2017, Clean Nordic Oceans was established as a clear organisation with clear objectives, which obviously filled a void as a Nordic meeting place for the issue and the project's core area: marine litter in relation to fishing activity.



By the end of the project, the network consisted of 110 registered participants, distributed across 89 different organisations, agencies, companies, etc. In addition, there have been many contributors through workshops, seminars, etc., who for various reasons have not wanted to join the network.

3.2 Knowledge acquisition and knowledge sharing

While sharing a number of similarities, the Nordic region is also geographically wide and diverse in many ways. For some Nordic countries and for certain specific thematic areas, using the network to obtain relevant information and knowledge was challenging. Through good and knowledgeable network contacts in our Nordic countries, it is nevertheless fair to say that Clean Nordic Ocean has worked methodically to become a trusted partner for knowledge acquisition.

Knowledge acquisition was conducted in several ways, but primarily through physical meetings such as workshops, which became an important arena. Follow-up dialogue between individual players in Nordic countries and the management of the Clean Nordic Ocean must also be emphasised as an important channel for knowledge acquisition. Through the Clean Nordic Ocean network, contact was also established with key people with various areas of expertise outside the Nordic region, for the simple reason that this could be useful for bringing new and important expertise to Nordic players.

Several knowledge acquisition sessions were held in the course of the project period. Whether these sessions should be categorised as knowledge acquisition or knowledge sharing is difficult to express clearly. At these sessions, some people contributed knowledge while others acquired new knowledge. The sessions thus served a dual purpose. We have therefore chosen to discuss knowledge acquisition and knowledge sharing in the same chapter. The most important physical sessions for this work during the project period are described below.

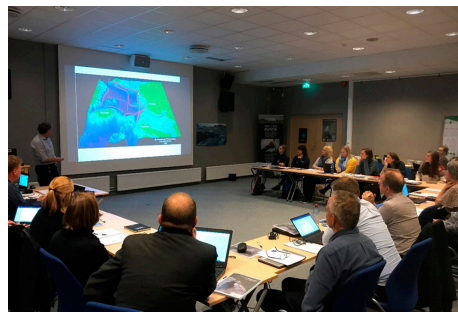
Clean Nordic Ocean start-up meeting – Copenhagen 2017

This was the project's physical start-up meeting, focusing on presentations and discussions of the knowledge status in the Nordic countries. All Nordic countries except the Åland Islands participated. Knowledge status means the knowledge each country possesses about the challenges and what measures have been taken.



Clean Nordic Ocean workshop – Runde 2018

In the autumn of 2018, a workshop was organised at Runde Environmental Centre, outside Ålesund, Norway. With a total of ten countries represented, knowledge was also collected from countries outside the Nordic countries. The session focused on possible solutions and measures for reducing the challenges in the various Nordic countries.



Clean Nordic Ocean seminar – Copenhagen 2019

Through workshops and networking in 2017 and 2018, it became clear that there was a need and a lack of knowledge with respect to systems for reporting lost fishing gear. A seminar was therefore held in Copenhagen, focusing on knowledge sharing related to such systems. Apart from the Åland Islands and Finland, all the Nordic countries participated in the seminar.



Clean Nordic Ocean co-organiser for the Lighthouse Lofoten conference – Svolvær 2019

In the autumn of 2019, the Norwegian government hosted the Our Ocean conference (<http://www.ourocean.com>), with a focus that included clean oceans. Prior to the main conference, there was an event focusing on marine litter, organised in Svolvær by the Norwegian Centre for Oil Spill Preparedness and Marine Environment with Clean Nordic Ocean as co-partner. The focus of this session was three-fold: 1) Joining forces and resources in coastal clean-ups 2) Lost at Sea: Prevention, retrieval and waste reception of marine litter from marine sources 3) From Coast to Coast: Global partnership and cooperation – tasks and ambitions. In total there were around 80 participants from around the world.



Clean Nordic Ocean closing conference – Gothenburg 2019

The closing conference for Clean Nordic Ocean naturally focused on presenting the work done by Clean Nordic Ocean during the project period, as well as findings and recommendations to help reduce the challenges facing the Nordic countries. Presentations also highlighted the many different projects in the Nordic countries that are making a positive contribution. There was also an international component that helped to put Clean Nordic Ocean's work in a wider perspective. Representatives from all Nordic countries participated, in addition to participants from several countries outside the Nordic region.



Sharing and spreading knowledge was one of the main tasks of the Clean Nordic Ocean project. In addition to the above-mentioned sessions arranged by the Clean

Nordic Ocean project, such as workshops and conferences, various media were used for to share and spread knowledge. Clean Nordic Ocean also created a separate communication plan.

Website

The Clean Nordic Ocean [website](#) was the main channel for sharing and spreading knowledge. The website was used to share information and knowledge through articles and events that were published about every two weeks. These were based on projects, measures, results and solutions. An article series was also created to describe the status and measures in each of the Nordic countries. During the project period, over 64 articles and a number of relevant events were published. These articles and events were visited by 108 different countries, indicating considerable interest in this topic. Table 1 shows which Nordic countries had the most visitors to the website and the number of visitors per capita. Of countries outside the Nordic region, the site was most frequently visited by 1. USA, 2. France, 3. the UK and 4. China.

Table 1: A ranking of the number of visitors to the website and visits per capita for the Nordic countries.

Rank	Total visitors	Visits per capita
1	Norway	Greenland
2	Denmark	The Faroe Islands
3	Sweden	Iceland
4	Iceland	Norway
5	Greenland	Denmark
6	Finland	Sweden
7	The Faroe Islands	The Åland Islands
8	The Åland Islands	Finland

Social media

Information was also shared through social media such as Twitter, Instagram and Facebook. There were posts about participation in working groups, as well as information on exciting articles that were published, relevant information films and other relevant information.

Films

Two film series were made, one aimed at recreational fishermen and the other at professional fishermen. The films were based on information obtained on the main challenges of these two important groups and had the overall goal of reducing ghost fishing and marine litter from fishing activity. The films used different approaches, with the films aimed at recreational fishing based on filling knowledge gaps and raising awareness about ghost fishing. The films addressed the following topics.

- How can fishermen avoid losing gear?
- What can you do when you lose fishing gear?
- How to report lost fishing gear (specific to Norway's app)



From the recording of the movie aimed towards recreational fishermen. The picture shows a camera and drone shot of a recreational fishermen.

One film was made that focused on professional fishermen. It focused on awareness and attitudes to fishing vessel routines to ensure that no scraps or smaller pieces of fishing gear are unaccounted. The film highlighted potential consequences. The films were distributed via various channels, including Clean Nordic Ocean's YouTube channel.

Participation in workshops, conferences and trade shows

Clean Nordic Ocean was invited to a number of meetings, workshops and conferences throughout the project period. These opportunities were used to share knowledge about CNO's activities and networking function. This greatly helped to show that the Nordic region is taking a holistic approach to a common challenge.

3.3 Key findings and recommendations

Key findings that have emerged through the Clean Nordic Ocean process largely apply to all countries, while some findings may be somewhat more country-specific with certain modifications.

Knowledge and information gathered during Clean Nordic Ocean's project period is described in the report under the status in Nordic countries and differences between the Nordic countries. This information was presented during the Clean Nordic Ocean closing conference in 2019 in Gothenburg, which also facilitated discussion and input. This contributed to constructive discussions in panel debates and through questions and comments from participants.

The report also describes measures and recommendations, which were prepared on the basis of findings, in conjunction with the challenges that Nordic countries have helped to highlight through the Clean Nordic Ocean project. In addition to the final report, a policy brief was also created. This is an aggregated compilation of the results of the report with the aim of providing advice to decision-makers in the Nordic countries.

Chapter 4: Knowledge base

Unaccounted fishing gear is not a new phenomenon. It is an unfortunate reality of both professional and recreational fishing. Lost fishing gear is probably the main reason for unaccounted fishing gear, but there are a number of other causes as well. In recent years, the materials used in fishing gear have generally become more durable and robust. This is challenging when gear is lost and plastic components that take a long time to decompose remain in the sea, presenting a risk of ghost fishing and marine litter. Unaccounted fishing gear is both unfortunate and undesirable. There are a number of reasons why fishing gear may be unaccounted for. This will be discussed together with potential measures that might also reduce the harmful effects.



Old ropes, pots and a buoy.

Photo: Natalie Greppi

While the challenges may be the same, not every measure will suit every country, fishery or port. Major differences in fishing fleets and specific challenges regarding lost fishing gear are key issues. Fishermen will face very different challenges in terms of weather conditions, bottom conditions and the capacity to take care of recovered and disposed fishing gear, reception facilities in ports and more. When considering differences in rules, regulations and the like at the same time, it is quite clear that there is no "one size fits all" solution. This chapter will first elucidate the various challenges and causes of marine litter and unaccounted fishing gear. Various measures will also be discussed that can help reduce the scope of ghost fishing and marine litter, and increase recycling and reuse from commercial and recreational fishing.

4.1 Experience from the Clean Nordic Oceans process

Chapter 3.2. describes the main elements of our operations that have contributed to a solid knowledge base. The degree of detail does, of course, differ for the various findings, but in this context we want to reproduce some of the main elements that have emerged through networking, workshops and conferences, which can then be used as a knowledge base. We will return to much of this in Chapter 4.2.

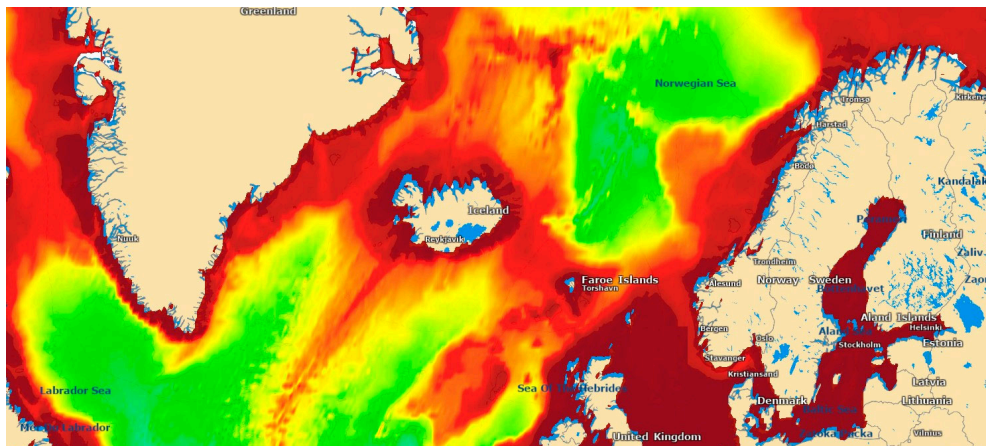
- A generally increasing focus on the challenges surrounding marine litter.
- Awareness and attitudes seem to be under-communicated and do not receive enough focus in relation to the consequences of scraps/pieces of fishing gear in the ocean.
- Large differences in knowledge of the extent of lost fishing gear and where it is lost.
- Little knowledge of rational and cost-effective methods of removal/clean-up.
- In general, few measures related to clean-up activities.
- Several countries have reporting requirements for lost fishing gear, but few have well-functioning reporting solutions.
- Recreational fishermen often lack expertise in handling fishing gear and this can more often result in lost gear.
- Professional fishermen have the expertise, but lack well-functioning systems for clean-up and need more knowledge about the consequences of lost fishing gear.
- Reception facilities in ports face very different challenges in the Nordic countries and are often linked to the number and size of ports.
- Limited logistical infrastructure for recycling recovered and scrapped fishing gear.
- Challenging to establish solutions for increased reuse.

The network around Clean Nordic Oceans has increased throughout the project period. It is relatively clear that there is a need for a Nordic forum for discussing these challenges.

4.2 Nordic differences

The significant differences between the Nordic countries represent a challenge to preparation of a complete and appropriate action plan that can be implemented in all the Nordic countries. The individual countries must therefore identify their own main challenges and find measures to meet these challenges. More information about these differences is available in Chapter 2.2, which deals with differences in:

- Oceanographic conditions
- Laws and regulations
- Infrastructure
- Fleet structure
- Scope of recreational fishing



A map over the Nordic region where a strong red color represent the shallowest areas and green represent the deepest.

4.3 Unaccounted fishing gear

Large quantities of new fishing gear are produced every year for both professional and recreational fishing, while much is scrapped and taken out of use. The lifecycle of fishing gear is poorly mapped and there is relatively little knowledge concerning this. Therefore, there is also scant knowledge about the amount of unaccounted fishing gear. However, there are differing perceptions of the term "unaccounted". If this term also includes gear that has not been delivered for reuse, recycling, disposal or that is properly stored so that it does not represent any risk, the amount of fishing gear that is "unaccounted" is likely to be large. Although the amount may vary between the Nordic countries, there is reason to believe that it is relatively large. There is a Norwegian study that focuses on the life cycle of fishing gear (Deshpande *et al.* 2020). When it comes to unaccounted fishing gear, it is reasonable to assume

that the largest amount is lost or abandoned at sea. However, accumulated knowledge clearly shows that there are rather large differences between fishing gear and types of gear in terms of risk of loss. The two main types of gear are active and passive fishing gear.

Experience also shows that the risk of losing fishing gear varies with a number of often external factors. However, recent knowledge also clearly shows that not all components of fishing gear found in the sea and on the beaches have been lost, but that there are a variety of reasons why it has become unaccounted for (SALT report no. 1033). This is often a matter of attitudes, routines and awareness.



A damaged trawl panel discarded at sea.

Photo: Wouter Jan Strietman

4.3.1 Active and passive fishing gear

In slightly simplified terms, passive fishing gear can be described as gear that is left in the sea as part of the fishing method. Time spent in the sea is defined as soak time or fishing time. Passive fishing gear does not require any form of motorised energy to accomplish the fishing method itself. Examples of such fishing gear are pots, gillnets and fish traps.

Active fishing gear, on the other hand, must be supplied with motorised energy to practice the fishing method itself. Examples of such fishing gear are trawls, purse seines and Danish seines. This type is less prone to the loss of entire items of fishing gear, but experience shows that components from this gear group are over-represented in marine litter found on beaches.

The big difference is that passive fishing gear needs time in the sea to catch fish, most often unattended and exposed to many different "risks", while active fishing gear is deployed and pulled in continuously and under the control of fishermen. Experience shows that this difference means that passive fishing gear is significantly more likely to be lost or damaged. Passive fishing gear also represents a greater risk of ghost fishing (Scheld *et al.* 2016).

Passive gear

There are many different situations that can cause passive fishing gear to be lost. Among other things, there may be a change in weather and current conditions, surface floats can be cut and ropes can snap when snagged on the bottom or in case of excessive catches. In fishing grounds where both active and passive fishing gear is used, it is not uncommon for active fishing gear to be the cause of lost passive

fishing gear. The most common causes of lost gear of this type are the following:

1. Surface floats that fall below the sea surface due to:
 - a. The current pulling the gear out to deeper water.
 - b. Miscalculations of the depth and bottom conditions resulting in an insufficient amount of rope.
 - c. Overgrown floats and rope, which results in the surface float sinking. This is largely due to the lack of tending or the fishing gear being left behind for other reasons.
2. Breakage between gear and surface floats due to:
 - a. Rope that is too weak, causing it to break when hauling in fishing gear.
 - b. Increased load on the rope as a result of snagging on the bottom, collision with gear or other objects on the bottom.
 - c. Ship traffic cuts away surface floats.
 - d. Poor quality of knots, causing them to become untied.
3. Other subsea activity.
 - a. Most often active fishing gear.



A gillnet for Greenland Halibut which has been "fishing" for a about 3 months and contains entangled, dead fish.

Photo: The Norwegian Directorate of Fisheries

Some of these causes are related to lack of knowledge and typically occur in recreational fishing, while other causes are less related to lack of knowledge and are therefore due to other types of actions.

Active gear

The challenge associated with lost gear is considerably less for active gear. This is because the gear is always attached to the vessel, which makes it easier to monitor

most causes of lost gear. Loss of entire items of gear is rare, but when it does occur, it is usually due to snagging on the bottom and rope/wire wearing thin. Another aspect related to this type of gear is that the gear is very expensive and is equipped with expensive instrumentation, so the vessels prioritise spending the necessary time dredging in order to recover the equipment. Although it is rare to lose entire pieces of gear, experience clearly shows that it is more common to find components from active fishing gear than from passive fishing gear. One of the most familiar components in this context is the "dolly rope" which is used under the cod-end to reduce wear on the cod-end itself.



A trawl equipped with a lot of dolly ropes (orange fibers).

Photo: Wouter Jan Strietman

4.3.2 Risk of losing fishing gear

There are many factors that can affect the risk of vessels losing all or part of their fishing gear. As such, it is not possible to rank the risk in a way that will be seen as exactly right for all countries or all fisheries in the Nordic region. However, comparing knowledge and experience allows us to rank the risk on a general basis. In Table 2, the risk of loss for types of fishing gear is weighted with a colour code and number, where green/1 is the lowest and red/5 is the highest.

Table 2: Assessment of risk of losing fishing gear.

Fishing gear	Level of risk	Explanation
Gillnets	5	Collision during use and pulled deeper by currents.
Pots	5	Cut floats and pulled deeper by currents.
Fish traps	4	Cut floats.
Trawls	2	Snagged on bottom. Large quantity of fish.
Danish seines	2	Snagged on bottom. Large quantity of fish.
Purse seines	1	Extreme weather conditions. Occurs rarely
Hook and line gear	3	Collision during use and wear while hauling in.

There is limited knowledge about the long-term ability of fishing gear to continue catching fish after loss. In the short term, however, the knowledge is clearer, although there will also be many individual differences that are not captured here. Even in the Nordic countries, experiences from various projects do not show clear

results. Nevertheless, there is sufficient reason to rank this risk for the different types of gear. Comparing knowledge and experience allows us to rank the risk on a general basis. In Table 3, the risk of ghost fishing is weighted with a colour code and number, where green/1 is the lowest and red/5 is the highest.

Table 3: Assessment of risk of ghost fishing by lost fishing gear.

Fishing gear	Level of risk	Explanation
Gillnets	5	The ability to catch fish is maintained after loss.
Pots	5	The ability to catch fish is maintained after loss.
Fish traps	5	The ability to catch fish is maintained after loss.
Trawls	2	The ability to catch fish is significantly reduced.
Danish seines	2	The ability to catch fish is significantly reduced.
Purse seines	1	Almost no ability to catch fish, little danger of snagging in small mesh holes.
Hook and line gear	1	Almost no ability to catch fish when bait is gone.

There is a real risk of lost fishing gear contributing to further losses when other gear gets snagged on the lost gear. This is not widely discussed in the literature, but snagging on lost fishing gear in fishery-intensive areas can be a greater challenge than expected, as demonstrated by experience from the annual Norwegian clean-up work. Comparing knowledge and experience allows us to rank the risk on a general basis. In Table 4, the risk of snagging on previously lost fishing gear is weighted with a colour code and number, where green/1 is the lowest and red/5 is the highest.

Table 4: Assessment of risk of snagging on previously lost fishing gear.

Fishing gear	Level of risk	Explanation
Gillnets	5	All fishing gear can snag easily.
Pots	3	Linked pots are susceptible for snagging.
Fish traps	2	Possible to pull up after snagging.
Trawls	4	Danger of snagging and difficult to get up.
Danish seines	4	Danger of snagging and difficult to get up.
Purse seines	4	Danger of snagging and difficult to get up.
Hook and line gear	3	Cover a large area. Hooks rust and become buried in sediment.

4.3.3 Waste procedures for fishing gear

New knowledge is constantly emerging that shows that small components and scraps from working on gear on board fishing vessels end up unaccounted for. Parts

of gear are found on beaches and are used by seabirds for nesting, among other things. In some cases, it is also found in the stomachs of both seabirds and fish. Of course, this is both undesirable and unfortunate. There may be varying reasons why pieces of gear end up in the sea and these may be related to poor procedures and attitudes. Also, it should not be ruled out that lack of waste procedures on board and limited reception facilities in some areas are more likely reasons why waste can go unaccounted for. There is little literature on this topic, but there is much to indicate that it is largely due to unconscious actions resulting from lack of procedures or the persistence of unfortunate older attitudes.



Fishery related litter at a beach on Svalbard.

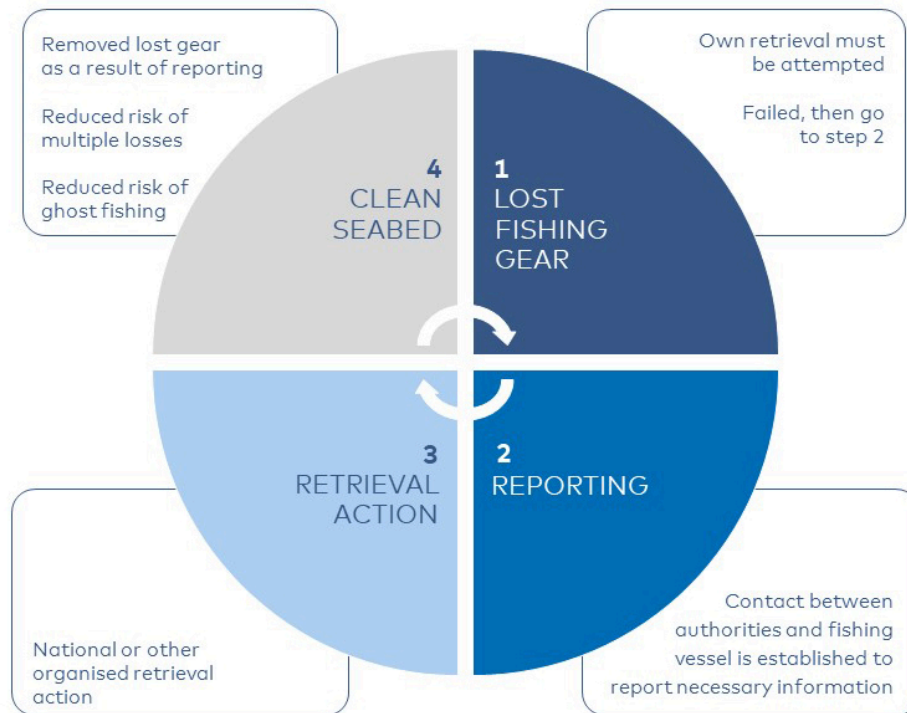
Photo: Wouter Jan Strietman

4.4 Reporting and clean-up

Many countries have requirements for reporting lost fishing gear, but few can document that this works as a system and few losses are reported. Several countries and supranational projects have tried to focus on clean-up, but this is very costly and challenging when the location of lost gear is unknown. One of the biggest challenges in implementing a clean-up system is the lack of position data for lost gear. Although a lot of countries have rules requiring the reporting of fishing gear losses, very few countries receive reports of lost fishing gear that include the location where the gear was lost. This may have several causes, but the main reason is probably unclear responsibility regarding who should be held financially responsible and who should organise the clean-up of lost gear based on reported positions. As a result, fishermen fear being held financially responsible for the loss of fishing gear and therefore often fail to report lost gear. This may also be due to a lack of follow-up and action on reported lost gear.

One of the countries that has a functioning system is Norway, and it is based on cooperation between the fishing industry and the authorities in order to make this work through established systems, illustrated in the figure below. There is also a clear and predictable financial responsibility, with the fishermen who report lost fishing gear not held directly financially responsible.

The cycle for following-up the reporting of lost fishing gear.



The main reason why this works well is a combination of what the fishermen is required to do relative to what is returned. In this context, it is very important to emphasise the importance of the fishermen's experience that the loss notification is handled seriously and followed up. Furthermore, it is considered important to clean-up the fishing grounds, with the opportunity of retrieving the gear.

It is important to emphasise that, as the result a working reporting solution with accurate positioning and supplementary information, this contributes to a faster and more cost-effective clean-up. In Norway, the fishing industry contributes more than 50 per cent of the funding to national annual clean-up, through a fee.

4.5 Receiving, handling, reuse and recycling

A common reason why old fishing gear goes unaccounted for is the lack of good reception systems in ports and/or the cost associated with further handling of the fishing gear when it is to be discarded. The gear can then often be stored at the quay, at warehouses, at fish reception facilities or, at worst, end up in the sea. This is of course both undesirable and unsustainable for all parties and can potentially harm both birds and animals, in addition to the risk of ghost fishing. Nor can it be ruled out that such storage over time can cause fragmentation into smaller pieces, which can then end up as fibres and potentially fragment further into microplastics.

The reason for large variations in reception systems in the Nordic countries is complex. Larger numbers of ports and poor infrastructure are cost drivers.

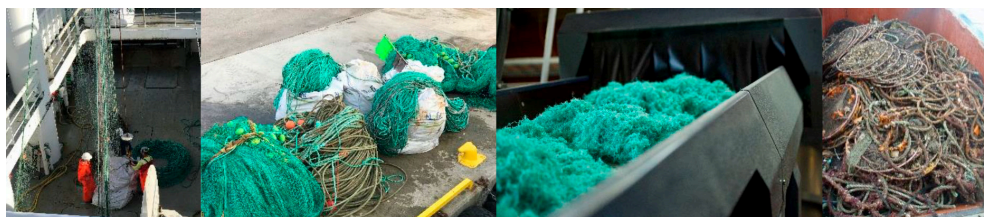
Circumstances related to costs and financing can therefore be decisive for receiving solutions.

Globally, circular economy is identified as important for the life cycle of fishing gear. Experience shows that both gear and many components of fishing gear can be reused. Some Nordic countries have a system for this, while others try on different scales and within certain gear segments. CNO believes it is important to try to find solutions for reuse and recycling, with proper delivery to landfills and incineration as the last resort. Possible solutions are outlined in the figure below.

Possible solutions from reception to disposal.



Fishing gear consists of many different components that are difficult or costly to separate. In addition, the gear often contains sand or mud, or it is fouled by biological material. These factors make it costly and less attractive to recycle such fishing gear. However, there are many factors that can affect the cost of recycling, such as type and condition of the gear. There are therefore major limitations as to what can be recycled profitably. Some types of gear are not recycled at all because they are considered too challenging from a cost-benefit perspective. Much of the fishing gear that cannot be recycled often ends up at incineration plants or in landfills.



Packing, sorting for reuse and recycling, recycling and unusable gear parts send to landfill or incineration.

Photo: The Norwegian Directorate of Fisheries and Plastix AS

In light of the circular economy, reuse may appear to be the most advantageous method for lost and discarded fishing gear. However, this is not possible for all types of gear, and the condition of the gear may also limit opportunities for reuse.

4.6 Laws and regulations

Laws and regulations are highly central and important when it comes to managing the Nordic seas responsibly. This is often done by prohibiting unwanted actions and placing restrictions on the utilisation of marine resources in an attempt to harvest marine resources sustainably. These are typically regulations that limit catch quantity, what fishing gear is allowed, reporting and marking requirements and much more. Many regulatory measures work very well, but sometimes challenges arise with ineffective regulations. This may occur because the regulations do not work as intended. A further potential challenge is that some laws and regulations can impede other desired measures. An example could be the removal of abandoned fishing gear that is prohibited in many countries when the gear is legally marked.

Chapter 5: Measures

The challenges of recycling, ghost fishing and marine litter from fishing activities are very complex and characterised by greater geographical and oceanographic differences. In addition, there are differences between fleet segments, fishing gear and fishermen in the different countries. Although the overall goal must be to stop all loss and dumping of marine litter from the fishing industry, there are many indications that it will be very challenging, if at all possible. It is important, therefore, to work along several lines, and in this report we have chosen to divide these areas into general measures, measures at sea and measures on land. We start with general measures and continue with key measures at sea and on land.

5.1 General measures

General measures apply both at sea and on land, as well to commercial and recreational fishing.

5.1.1 Awareness and attitudes

A number of studies and documentation show that a significant amount of marine litter comes from professional and recreational fishing. There are also studies showing that fishery-related waste represents a significant proportion of beach litter, although there are some geographical variations. We know from experience that lost fishing gear found on beaches is rarely intact. Usually, there are various sizes of components of fishing gear. There is also documentation that shows with great certainty that many of these components end up in the sea due to poor routines and attitudes ("SALT report No. 1033").



From a bird nesting area in Norway containing a lot of ropes, and other fishery related pieces.

Photo: Arild Hareide, Runde Miljøsender

A number of news publications also show that seabirds are increasingly building nests from scraps and other small components from fishing gear. Components from fishing gear have also been found in the digestive systems of fish, birds and other animals, which can cause suffering and death for the individuals concerned. Of

course, this is undesirable for everyone, but at the same time it says a lot about our lack of awareness and poor attitudes to the ocean, as well as our inability to consider the consequences of a moment's action. As a result of the work done by Clean Nordic Oceans, we believe there is reason to claim that these attitudes are changing, but this change can take time if it is not promoted and supported. Support is based primarily on knowledge relating to the consequences and procedures on vessels that reduce the risk of such waste entering the sea.

Awareness and attitudes are basic and governing, and at the same time, so easy to improve if there is the necessary will and ability. Clean Nordic Oceans found this so important that we chose to make a film focusing on the theme of awareness of waste procedures on board. Furthermore, we recommend the following measures.

- The consequences of smaller pieces of fishery-related waste in the sea are under-communicated and do not receive enough attention. This applies to both recreational and professional fishing. This must be strengthened as part of an effort to improve attitudes and procedures concerning clean seas and responsibility for marine life. This applies to all users of the sea.



Reindeer entangled in a trawl net at Svalbard.

Photo: Governor of Svalbard

5.1.2 Regulations and legislation

Regulations and legislation on unaccounted fishing gear should be reviewed in terms of whether the legislation works as intended and whether it restricts other appropriate measures. This is to help reduce the harm caused by gear that goes unaccounted for. For example, gear requirements may prohibit the sale of pots that do not have a solution for escape holes, or geographical restrictions, such as a ban on fishing around wrecks, as gear can quickly snag in the wrecks. Another example of regulations is restrictions on the amount of passive fishing gear used. Regulations preventing effective recovery of lost fishing gear should also be reviewed. An example of this is legislation relating to abandoned gear where the name of the owner is known.

5.2 Measures at sea

In order to reduce the risk of waste, or of fishing gear being abandoned, lost or dumped, the general idea is that preventive measures are most cost-effective (Macfadyen *et al.* 2009). These could be measures such as marking and making fishing gear visible, and improved on-board procedures that can be performed by following FAO's code of conduct for responsible fishing, for example (CADDY, John *et al.* 1996).

Although the most important thing in terms of marine litter is to stop the supply of new waste, it must be acknowledged that the loss of fishing gear is inevitable. This has to do with weather, wind and other oceanographic conditions, in addition to fishing methods and operating patterns. As such, it is very important to find good solutions for locating lost gear and to have good solutions for retrieving lost fishing gear.

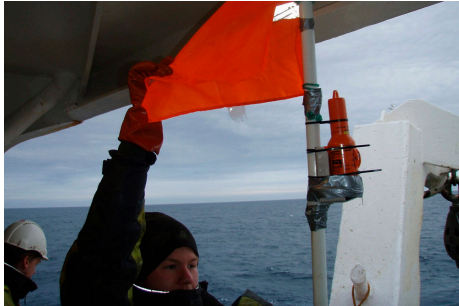
In view of this, the measures at sea proposed by Clean Nordic Oceans are considered to be the most appropriate and effective. The measures are presented in six sub-chapters, "Making fishing gear visible", "Marking of fishing gear", "Technology for avoiding unwanted bottom contact", "Improving procedures", "Locating lost fishing gear" and "Retrieving lost fishing gear". The first four chapters apply to gear before it is lost, and the last two apply to gear after it is lost.

5.2.1 Making fishing gear visible

One of the main causes of fishing gear being lost is conflicts between different fisheries. Typically, this can occur between active and passive fishing – for example, a collision between a fixed gillnet and a trawl pulled along the bottom. There may also be conflicts between passive fishing gear and other ship traffic. Specific examples are gillnets with floats that are cut or pulled away by ship traffic because the nets are placed in a shipping lane or transit zones for larger vessels.

Solutions to these challenges include ways in which to make passive gear more easily visible through better marking of buoys by using lights, flags, reflectors or radar reflectors, for example. The use of position marking on buoys will enable vessels to see them on monitors and other on-board tools, thereby reducing the risk of lost fishing gear. Another solution is to make real-time maps showing the exact positions

of passive gear available online to help vessels using active fishing gear and other ship traffic avoid fixed passive gear. This has been done with great success in Norway, where real-time maps of passive gear are available through publicly available map solutions (<https://www.barentswatch.no/en/fishinfo/>).



Example of gear marking at surface, with a orange flag, reflex and AIS.

Photo: The Norwegian Directorate of Fisheries

5.2.2 Marking of fishing gear

The marking of fishing gear is currently regulated by requirements for identification on surface floats. For identification, there are currently various solutions linked to e.g. fishery registration number, IMO number or personal identification. There are few regulations and little practice in terms of marking the actual fishing gear on the seabed. Among other things, this means that the owner cannot be identified when the surface float is missing. In some cases, fishing gear is abandoned or deliberately dumped into the sea, and this can be for a variety of reasons. One potential solution to this challenge is to mark the fishing gear itself with information that identifies the owner. This will act as a disincentive to abandoning or dumping fishing equipment at sea. The marking of the fishing gear itself can therefore contribute to increased reporting of lost fishing gear and possibly improve the possibility of return on recovery. There are a number of different methods that can be used for marking fishing gear. Some methods are manual solutions, while others are based on digital identification (FAO. 2019. "Voluntary Guidelines on the Marking of Fishing Gear").

5.2.3 Technology to avoid unwanted bottom contact

Both active and passive fishing gear is lost when ropes and wires break. This occurs when gear snags on the seabed or man-made objects such as wrecks or other objects. One solution to these challenges is seabed maps that highlight important details. Such a solution relies entirely on regular updates to include new hindrances. This will improve the chances for fishermen to avoid obstacles. An exception here is wreck fishing, where gillnets are set up around shipwrecks because they attract fish. There is often a higher concentration of fish around shipwrecks, which provides better fishing opportunities. Consequently, a lot of gear is lost around shipwrecks, and it remains on the wreck, where it continues to catch fish. There are no simple solutions to this challenge other than limiting wreck fishing.

5.2.4 Improving procedures

In commercial fishing, it is important to have good procedures for ongoing handling of fishing gear on the vessel, including setting and hauling. Such procedures are based on responsible and safe handling of fishing gear in relation to surrounding factors such as current and bottom topography. Although fishermen have a high level of experience in operating at sea, they do stretch the limits with regard to what fishing gear can withstand. This can cause damage and loss of fishing gear. To meet these challenges, the FAO has created a manual of best practice for responsible fishing (CADDY *et al.* 1996).

In recreational fishing, poor knowledge has been identified as a major cause of lost fishing gear. Accordingly, it is important to raise the level of knowledge among recreational fishermen, who are often inexperienced and lose gear as a result of human error. Therefore, targeted information campaigns may also be a very good measure for recreational fishermen. CNO has produced training videos in several languages, which are available on CNO's YouTube channel:

<https://www.youtube.com/channel/UCnZDfCIUNGaKPR-TNWjrKmg>

Measures aimed at professional fishermen must be more of an "awareness-raising" nature, such as showing the consequences of scraps and repair materials falling into the sea. An example of this can also be seen on CNO's YouTube channel.

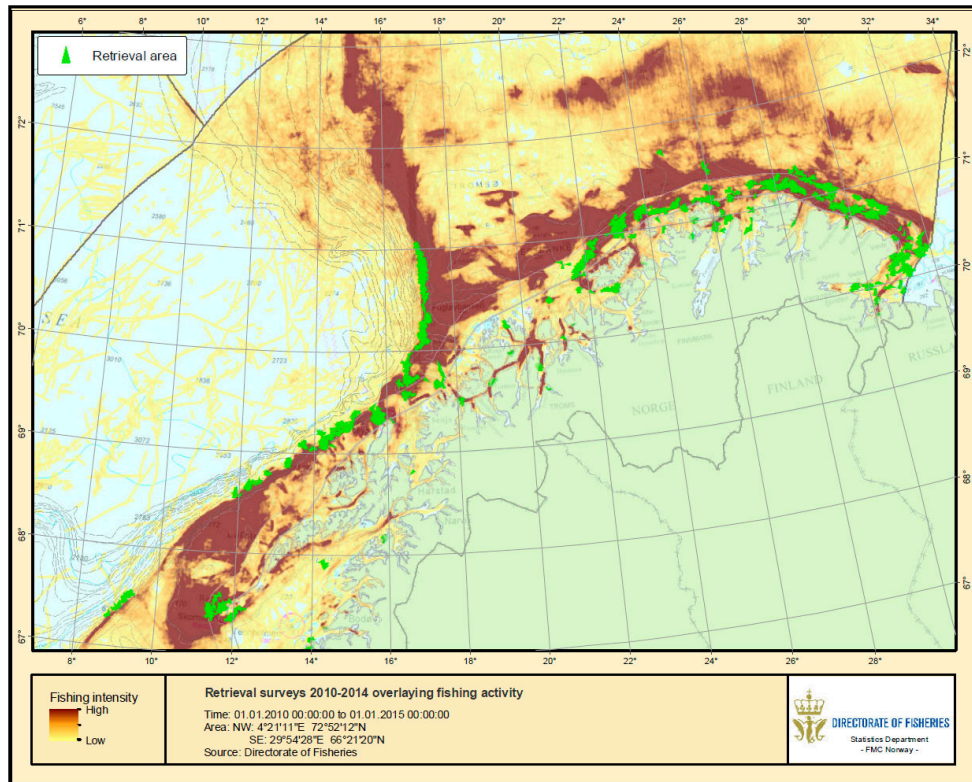
5.2.5 Locating lost fishing gear

In order to be able to implement effective measures for gear clean-up, it is crucial to know the location of the lost gear. Lost gear can be located in a number of ways, but this can be divided into three main groups. These groups are: reported positions from fishermen, hotspot-based mapping and positions based on retrieval devices.

Reported positions from fishermen

"Reported positions" means that the fisher who has lost the gear reports what gear was lost, how much was lost and, most importantly, where it was lost. This is definitely the most cost-effective way to report lost gear. The degree of participation can be defined through reporting requirements. One of the biggest challenges with this method is fishermen not bothering to report lost gear. This can be a mix between professional pride and the risk of being held financially responsible for a potential clean-up job. Many countries require fishermen to report lost gear if they can't retrieve the lost gear themselves. Nevertheless, there are few reports in most countries.

One country that has established a good system of fishermen reporting lost gear is Norway. This is probably due to good cooperation between the fishery authorities and the fishing industry, which ensures that loss reports are followed up through annual clean-ups. However, it is important that fishermen themselves attempt to retrieve their own lost gear.



A visualization of fishing activity on a heat map where red areas are most activity. Areas for the Norwegian retrieval survey after lost fishing gear are visualized with green.

CC: The Norwegian Directorate of Fishery

Hotspot-based mapping

"Hotspot-based mapping" means surveys of predefined areas where it is assumed that there is a significant amount of lost gear. These studies can be performed in many ways, but the most common is by using underwater cameras placed on remotely operated underwater vehicles (ROV) or by using high-resolution acoustics, generally using a submersible probe or side-scan sonar. In this way, hotspots can be mapped in detail and the position of lost gear recorded for a clean-up operation at a later date. Disadvantages of this approach are that it is costly and that the survey requires data on where the hotspots might be located.

Positions based on retrieval devices

A lot of research is being done on various technological solutions for reducing the risk of ghost fishing and relevant products have started to come on the market. One of the most promising solutions is recovery sensors. A typical concept of such a retrieval sensor is a device attached to a piece of gear. This device will emit a signal that can be acoustically intercepted at the surface. However, there are also other concepts with different solutions.

Another type of technology is based on a simpler concept with a device mounted on the fishing gear that sets a new surface marker after gear is lost. For example, this could be a device that attaches to a pot and is connected to a degradable release

mechanism. Such devices can be used to provide fishing gear with a new surface float after a certain time at sea. 5.2.6 Retrieving lost fishing gear

Retrieving lost fishing gear and parts of gear from the sea is very challenging and can be done in different ways. While the main challenge is the technical solutions for recovering lost gear, the unclear responsibility that prevails in many Nordic countries is also a challenge. It is very important, therefore, to consider the financial factors in relation to clean-up. Clarifying responsibilities is important in order to achieve continuous and efficient retrieval of lost fishing gear, and this can be decisive for reporting. The polluter pays principle should be used, but not in such a way that it becomes a burden on individual fishermen for the loss reported. Therefore, there should be a financial solution whereby the fishing industry contributes to financing an organised clean-up system.

There are several different methods that can be used to retrieve fishing gear, each with its advantages and disadvantages. This chapter will consider these methods and evaluate them based on cost, efficiency, impact on the seabed and risk of injury to personnel while retrieving the lost gear. For practical reasons, we divide the methods into three subgroups: dredging, diving and using ROVs.

One of the established seabed clean-up systems for marine litter in general, including fishery-related waste, is called "Fishing for Litter". This is a system that is based on fishing boats taking all the waste they collect during their fishing operation back to shore, where they can deliver this waste free of charge in port. For information about "Fishing for Litter" visit <http://www.Fishingforlitter.org>.

Dredging

Dredging is a method typically performed by dragging an anchor or a specially designed dredging solution behind a vessel with the aim of having the anchor snag the lost gear. The operation depends on both hitting and snagging the target, which is crucial for bringing the gear up. Dredging seems to be the best way to recover lost fishing gear based on the parameters of efficiency, cost and risk to personnel, but only in situations where there is information about the gear. This is especially information about the position and the direction of the implement, but the amount and scope of the gear is also useful information. The latter simplifies the clean-up as this increases the chance of the grapple hook hitting the gear to be retrieved. Clean Nordic Oceans has made a brief introductory film on how recreational fishermen can dredge for lost gear: <https://www.youtube.com/watch?v=I9Gv9zaEORc&t=11s>



A dredge attached to a lost gillnet.

Photo: The Norwegian Directorate of Fisheries

Disadvantages of this method are that it requires information about the lost gear and how it was lost, the impact on the seabed, the risk of the grapple hook getting stuck and other considerations related to the weather conditions. It is important to perform short and precise dredge hauls that reduce contact with the bottom to a minimum and reduce the chance of gear becoming covered in sediment. In addition, there must be a thorough survey to ensure that dredging is not performed in vulnerable seabed areas.

Diving

Diving is a very low-impact and thorough clean-up method, which at the same time allows for relatively advanced diving operations e.g. when the gear is stuck on the bottom or on shipwrecks, which can be challenging with other types of clean-up. However, it is a relatively time-consuming operation, and it is limited to the depth at which the diver can operate. There is also a significant risk associated with diving as a clean-up method. There is a risk that the diver may become entangled in the lost gear, and therefore such dive operations (especially involving lost gillnets) should be performed by experienced divers.

In sum, the use of divers for clean-up is a good supplement to dredging in shallower, coastal areas. Another challenge related to diving that is common to many of the Nordic countries is the lack of public information as to whether or not recreational divers may remove lost gear. This is especially true where divers are paid to do this work. Clean Nordic Oceans has noted that recreational divers do a very good job in some Nordic countries. The authorities in the respective countries must make a decision regarding the use of voluntary divers for clean-up activities, especially when using public funds.

Remotely operated underwater vehicles

Remotely operated underwater vehicles (ROVs) are effective at picking up lost fishing gear when the gear is sitting loose on the bottom, is easy to locate and the depth is not too great. There is a wide variety when it comes to ROV equipment, but common to most ROVs is that they are equipped with a monitor and camera, which allows the operator to sit on board a boat and control the operation from there. Operations using ROVs are associated with low risk. At the same time, the ROV can be equipped with a gripping claw to pick up the gear or to attach a rope to the gear which is also in contact with the surface. ROVs therefore represent a simple, low-impact and targeted approach to clean-up work. The challenge with ROVs is that there can be low visibility at the bottom, which makes it difficult to locate lost gear, and ROVs often have limited engine power, which means that it can take a lot of time to manoeuvre to the right place and that they can be greatly affected by ocean and tidal currents.

Clean-up with ROVs can in many ways be compared to diving, but it is less suitable for complicated clean-up operations. At the same time, the risk is considerably less and ROVs can reach deeper areas. Therefore, ROV clean-up is very suitable in coastal areas. Another challenge with ROVs is that they are complicated and often costly machines, but increased demand and technological developments have improved their usability, in addition to reducing costs dramatically in recent years. The price has been reduced to such an extent that private individuals can invest in this

equipment to clean up lost gear in their spare time, often through clubs and smaller organisations. CNO therefore hopes and believes that an environment will emerge with people who are interested in cleaning up coastal areas in their spare time. As such, this is a great tool to involve engaged private individuals without any particular risk as compared to diving.



An old pot retrieved by a ROV.

Photo: Green-Bay Project / Tord Aslaksen

Experience from using ROVs at greater depths than the coastal zone in relation to dredging is poor. During the Norwegian clean-up campaign, a seven-day experiment was conducted using ROVs. The result showed that this is more costly and more time-consuming than dredging. In addition, the results were poorer than dredging for similar objects.

5.3 Measures on land

There are several measures that can be implemented on land, but one of the main measures is based on the reception and handling of fishing gear. This is to ensure that scrapped, abandoned and lost fishing gear is removed and handled in a way that prevents harm. The second key measure is related to the design and materials used for various solutions that can reduce waste and ghost fishing, and make recycling easier.

5.3.1 Receiving and handling

The dumping and abandoning of scrapped fishing gear is a challenge, but perhaps one of the easiest for which it is possible to find effective measures. The most effective measure will likely be to facilitate reception in ports. As mentioned earlier, there are large variations in the numbers and the sizes of fishing ports in the different countries. Therefore, reception facilities should be adapted to the needs of the individual ports. In small ports, for example, a possible solution could be to have a container at the nearest fish reception facility or to have a regular and pre-announced collection of fishing gear in individual fishing ports. Larger ports should arrange for year-round collection of fishing gear, perhaps with more specialised solutions that promote sorting and pre-processing.



Illustration of how reception could look like.

Photo: The Norwegian Directorate of Fisheries

The economic aspects of facilitating reception at ports are more complex and will probably involve even greater differences between countries and the size of the fishing port. A typical measure would be to increase the price of waste delivery, but there is reason to believe that reducing prices for fishing vessels will lead to better waste management, while increasing prices could increase abandonment and dumping. Therefore, it seems sensible to look at alternative solutions. An obvious solution for meeting these challenges is from the perspective of a circular economy. This means adding an economic aspect to the life cycle of fishing gear. One way to achieve this is by introducing a “buy back” system whereby fishermen receive a refund, a lump sum for the returned equipment. This is a system that gives discarded fishing gear a value and acts as a kind of deposit system. A deposit system for fishing gear may also represent an opportunity for increasing the incentive to find lost fishing equipment by bringing value into the life cycle. This can be integrated with the introduction of a scheme to make manufacturers responsible for their products. In other words, manufacturers are given responsibility for starting and completing the life cycle of fishing equipment.

Another method of adding value to the life cycle is through increased focus on sorting and preparation of fishing gear. These are solutions such as separating and washing various components. Separating components and cleaning gear would reduce the cost of the recycling process, which in turn would reduce costs in the life cycle of the fishing gear. Thus, benefits could be realised by rewarding fishermen for good pre-processing. Furthermore, this measure could increase focus on the recycling of fishing gear. Increased focus on repair and reuse will extend the life cycle of fishing gear, which in turn will result in less waste. It could also stimulate an increased market for used gear, which would then contribute another economic aspect to the gear’s life cycle. For many types of gear, repairs and extended service life are highly possible, and this is particularly relevant for the types of gear that are difficult to recycle. This is accordingly a step towards a circular economy that would avoid several of the challenges that arise when fishing gear is recycled.

5.3.2 Materials and design

For abandoned, lost or scrapped fishing gear, it is very difficult to inject profitability into the recycling process. The main reason for this is the pre-processing of the gear, as fishing gear often consists of interlaced components of different materials and

qualities. This makes it difficult to handle and pre-process the fishing gear and is a strong driver for the high costs related to recycling fishing gear. In order to meet this challenge, radical changes are required, with one of the most relevant measures being to look at alternative solutions for how fishing gear is manufactured. In particular, alternative designs or materials should be considered.

Employing alternative designs for fishing gear could solve a number of challenges and there are, for example, solutions that make the fishing gear easier to separate into homogeneous material groups. Sorting into homogeneous material groups involves separating the gear into groups of components consisting of the same material e.g. the same type of plastic (polymer). Alternatively, there may be designs that use more of the same types of plastic in the construction of the gear. For example, crab pots often have a plastic-coated metal frame that is very labour-intensive to separate.

Another challenge is wear from contact with the seabed. This is a particular challenge for bottom otter trawls and Danish seines. Bottom otter trawls are occasionally fitted with dolly ropes consisting of composite plastic threads. This is to avoid wear on the cod-end. These plastic threads come loose, are lost and are found in large quantities along the Nordic coast. Rope on Danish seines is also subjected to excessive wear during use, which releases a lot of plastic fragments, and the ropes must be changed regularly. By looking at alternative designs that could reduce wear, this type of fishing gear could release less plastic.

Alternative material types refer to materials with special features that could, for example, make gear biodegradable. Biodegradable gear is gear that consists of biological materials that do not release chemical components such as plastic during the decomposition process. This property would be especially beneficial for passive gear, which is lost more frequently than active gear. However, there are challenges associated with this technology and some studies have pointed to reduced fishing efficiency and elasticity (Grimaldo *et al.* 2019).



A biodegradable cotton thread in a pot.

Photo: Institute of Marine research



A biodegradable gillnet.

Photo: Eduardo Grimaldo, Sintef

There is also another use of biodegradable materials that has a lesser impact on catching efficiency, i.e. making the gear partially biodegradable or using biodegradable components. For example, this can be done by replacing components that are often lost or reducing ghost fishing by inserting degradable panels or cotton threads into crab pots. Most notable is the idea of implementing a cotton thread, which breaks down quickly, in pots, leaving an escape hole after the thread is broken down. Such solutions already exist in a number of countries and should be considered by additional countries.

There is increased focus on biodegradable solutions that reduce the risk of ghost fishing and other long-term effects of lost fishing gear. However, this should not preclude the consideration of using materials that make certain types of gear and gear components stronger and less prone to wear and tear. This can reduce the risk of loss, while also extending the service life, which in turn would contribute to lower turnover rates and reduce the need for replacement. However, this must be assessed against the potential risk that this may entail in the event of loss of gear or gear components.

Chapter 6: Key findings

Clean Nordic Oceans is not a research project where findings are presented with accompanying documentation. These are findings that have emerged as a result of our networking work and contributions from experts at workshops and conferences. The findings reflect the Nordic region.

Finding 1.

Nordic countries have a low overview of the quantity and location of lost fishing gear. Although there are regulations with reporting requirements, few countries have functioning systems for reporting lost fishing gear from professional and recreational fishing. This is apparent from absent or abnormally low loss figures in relation to the country's total fishing activity and type of fishing. This under-reporting is unfortunate in light of the knowledge that fisheries and recreational fishing constitute a significant proportion of the marine litter from sea-based sources.

Finding 2.

Nordic countries focus little or no effort on removing lost fishing gear. The lack of effective reporting solutions weakens the basis for carrying out rational and cost-effective clean-up operations, but the challenges surrounding lost fishing gear remain the same. With the available knowledge of ghost fishing and decomposition time, this is both unethical and unfortunate. Only one country carries out annual clean-ups, while a few countries carry out project-based efforts to remove lost fishing gear.

Finding 3.

There is a significantly greater risk of losing passive fishing gear (e.g. gillnets, pots and fish traps) than active fishing gear (e.g. trawls, purse seines and Danish seines). Experience-based knowledge clearly demonstrates this fact. This is also natural in view of the fishing methods themselves. However, it is important to emphasise that, while the risk is greatest for losing passive fishing gear, components from active fishing gear are over-represented in fishery-related beach litter, such as dolly rope, among other things.

Finding 4.

Awareness-raising initiatives appear to be insufficient in all Nordic countries. The reason that smaller pieces of fishing gear end up in the sea as a result of e.g. repair work is probably due to a mixture of conscious and unconscious actions, partially attributable to a lack of routines and partially to prevailing attitudes. Ghost fishing

and other consequences of lost gear can harm and, at worst, cause the death of marine animals. This is under-communicated and does not receive enough attention in either commercial or recreational fishing.

Finding 5.

Significant differences between Nordic countries in terms of organised and in some places lacking reception solutions for recovered and scrapped fishing gear. Countries with few but major central fishing ports have established good reception solutions. Countries with a larger range and number of ports do not have solutions that are satisfactory and comprehensive, especially for the less mobile part of the fishing fleet. There are also some major differences in terms of national infrastructure and coordinated terms for delivering fishing gear.

Finding 6.

Major challenges relating to the reuse and recycling of fishing gear in general and to recovery of lost fishing gear. It is possible to reuse recovered fishing gear and components from scrapped fishing gear, but operating costs make it difficult to establish a system for this. Recycling of fishing gear is generally costly because gear must be disassembled and prepared for recycling, and because some products cannot be recycled. For recovered fishing gear, there is an additional challenge related to the incorporation of foreign particles and biological material into the gear.



A rotten fish in a lost gillnet.

Photo: The Norwegian Directorate of Fisheries

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Gjermund Langedal, prosjektleder, Fiskeridirektoratet. Bård Aarbakke, Fiskeridirektoratet. Finn Larsen, Danmarks Tekniske Universitet. Charlotta Stadig, Havs- och vattenmyndigheten.

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Nordic Council of Ministers/Publication Unit
Ved Stranden 18
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Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland and Åland.

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Nordic co-operation promotes regional interests and values in a global world. The values shared by the Nordic countries help make the region one of the most innovative and competitive in the world.

The Nordic Council of Ministers

Nordens Hus
Ved Stranden 18
DK-1061 Copenhagen
pub@norden.org

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