OSPAR COMMISSION

Assessment of the impact of dumped conventional and chemical munitions (update 2009)

Biodiversity Series

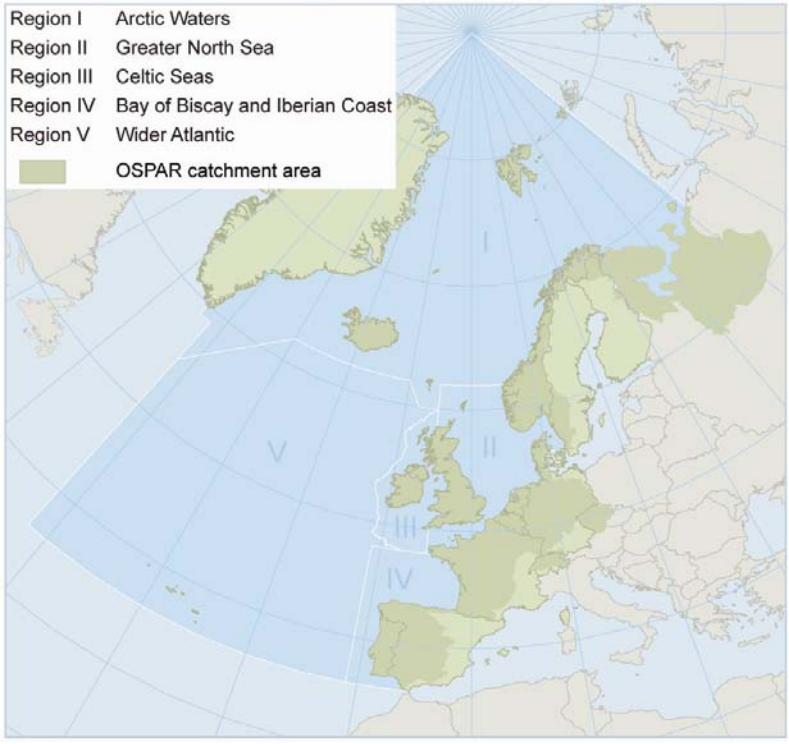
2009

OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the “OSPAR Convention”) was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. It has been ratified by Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Sweden, Switzerland and the United Kingdom and approved by the European Community and Spain.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998.
La Convention a été ratifiée par l'Allemagne, la Belgique, le Danemark, la Finlande, la France, l’Irlande, l’Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d’Irlande du Nord, la Suède et la Suisse et approuvée par la Communauté européenne et l’Espagne.



The OSPAR maritime area and its five Regions

Acknowledgement

This report has been prepared by Mr Eugene Nixon, Marine Institute, Ireland.

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Executive summary

Large amounts of munitions were dumped in the OSPAR maritime area causing environmental and safety concern

Following World Wars I and II, large amounts of munitions were dumped in the OSPAR maritime area, including conventional munitions such as bombs, grenades, torpedoes and mines as well as phosphorus incendiary devices and chemical munitions containing for example mustard gases. Dumped chemical and conventional munitions are causing environmental and safety concerns in many parts of the world, including in the OSPAR maritime area. In 2005, three fishermen lost their lives in the southern part of the North Sea when a World War II bomb exploded on board their fishing vessel after having been hauled aboard in their nets. Information on the quantities of munitions dumped and their location is limited and of dubious accuracy, giving rise to concerns about the potential danger posed to marine and coastal users. Estimates suggest that in excess of one million tonnes of munitions were dumped in Beaufort's Dyke (Irish Sea), 168 000 tonnes in the Skagerrak and 300 000 tonnes in the North Sea. The biggest dumpsites in the OSPAR maritime area are located in OSPAR Regions II and III.

Historical dumpsites are spread over the entire OSPAR maritime area

The OSPAR Framework for reporting encounters with marine dumped chemical weapons and munitions (Recommendation 2003/2) established a reporting system for Contracting Parties of known dumpsites and encounters with munitions. This has revealed at least 148 dumpsites spread over the entire maritime area from Iceland to Gibraltar. Of these, conventional munitions were dumped in 78% of the sites and chemical munitions in 20%. Chemical munitions were generally dumped in deeper offshore waters. A total of 1879 encounters with munitions were reported by Contracting Parties over the period 1999 - 2008 for the whole maritime area. The majority of these (85%) were described as conventional munitions and over half were reported by fishermen. The second most frequent category of encounter was on the shore. In 76% of the munitions encounters the hazard was totally removed or neutralised. The OSPAR Agreement on a Framework for developing national guidelines for fishermen on how to deal with encounters with conventional and chemical munitions (Agreement 2004-9) assists Contracting Parties in providing information to fishermen on areas at risk, gives a general description of munitions and chemical agents, their effects and first-aid treatment and what to do in the event of an encounter.

Fishermen in the southern North Sea are most at risk from munitions encounters

Based on the available information, fishermen in the southern part of the North Sea are most at risk of encountering munitions and these encounters are most likely to be with conventional munitions. This type of reporting allows authorities to focus efforts on areas where the risk of past dumped munitions is greatest, for example fishermen involved in seabed trawling in the southern part of the North Sea. To this end the issuing of guidelines to fishermen on what to do when munitions were encountered and supplying them with a subsurface marker buoy is considered best practice.

Chemicals released from munitions may have negative impacts on marine ecosystems

There is a possibility that hazardous substances, released from both chemical and conventional munitions, may have negative effects on the marine environment and enter the food chain. Today, there is no evidence that this has occurred yet, however, increasing corrosion rate of metal casings may possibly lead to impacts in future. Explosions associated with dumped munitions may affect

marine species. Marine mammals or fish can be hurt or even killed by the shock wave and the high sound pressure following an explosion. Harbour porpoises may be killed within four kilometres of large explosions and their hearing can suffer permanent damage as far away as 30 kilometres.

More information is needed on past dumped munitions

Knowledge is improving, but there is lack of accurate information on the quantities, state and current location of past dumped munitions. This makes management of dumped munitions difficult and there are serious safety risks associated with cleanup of marine munitions dumpsites. New techniques using remote controlled technology are showing some promise but are currently not widely used. In light of this, management of the risk from dumped munitions should be considered when planning and managing other relevant marine activities. OSPAR Contracting Parties should continue reporting on munitions encounters and dumpsites and consider changing the regular reporting under Recommendation 2003/2 every three years to annual reporting. OSPAR should also consider options for promoting research and monitoring of possible effects of dumped munitions on the marine environment of the North-East Atlantic.

Récapitulatif

Grandes quantités de munitions immergées dans la zone maritime OSPAR causant des préoccupations pour l'environnement et la sécurité

A la suite de la première guerre mondiale des grandes quantités de munitions, notamment des munitions conventionnelles telles que des bombes, des grenades, des torpilles et des mines, ainsi que des dispositifs incendiaires au phosphore et des munitions chimiques contenant par exemple du gaz moutarde, ont été immergées dans la zone maritime OSPAR. Les munitions chimiques et conventionnelles immergées causent des préoccupations en matière d'environnement et de sécurité dans de nombreuses parties du monde, et notamment dans la zone maritime OSPAR. En 2005 trois pêcheurs ont été tués, dans la partie méridionale de la mer du Nord, par l'explosion à bord d'un navire de pêche d'une bombe datant de la deuxième guerre mondiale qui avait été ramenée à bord dans leurs filets de pêche. Les informations sur les quantités de munitions immergées et leur emplacement sont limitées et peu précises, aggravant les préoccupations quant à leur danger potentiel pour les utilisateurs marins et côtiers. On estime que plus d'un million de tonnes de munitions ont été immergées dans le Beaufort's Dyke (mer d'Irlande), quelque 168 000 tonnes dans le Skagerrak et quelque 300 000 tonnes dans la mer du Nord. Les plus grands sites d'immersion de la zone maritime OSPAR se trouvent dans les Régions II et III OSPAR.

Les sites historiques d'immersion éparpillés sur l'ensemble de la zone maritime OSPAR

Le cadre OSPAR de notification des contacts avec des munitions conventionnelles et chimiques immergées en mer a mis en place un système de notification des sites d'immersion connus et des contacts avec des munitions (Recommandation 2003/2), à l'intention des Parties contractantes. Ceci a révélé au moins 148 sites d'immersion éparpillés sur l'ensemble de la zone maritime allant de l'Islande à Gibraltar. Des munitions conventionnelles ont été immergées dans 78% de ces sites et des munitions chimiques dans 20%. Les munitions chimiques sont généralement immergées dans des eaux plus profondes de la haute mer. Les Parties contractantes ont notifié au total 1879 contacts avec des munitions entre 1999 et 2008 dans l'ensemble de la zone maritime. La majorité d'entre elles (85%) sont considérées comme des munitions conventionnelles et un peu plus de la moitié ont été notifiées par des pêcheurs. La deuxième catégorie de contacts les plus fréquents a lieu sur le rivage. Le danger que présentent ces munitions a été totalement éliminé ou neutralisé dans 76% des cas.

L'accord OSPAR sur un cadre d'élaboration des lignes directrices nationales destinées aux pêcheurs, sur la manière de traiter les contacts avec des munitions conventionnelles et chimiques (Accord 2004-9) permet aux Parties contractantes de fournir aux pêcheurs des informations sur les zones à risque, une description générale des munitions et des agents chimiques, leurs effets et les soins d'urgence et la marche à suivre en cas de contact.

Les pêcheurs de la partie méridionale de la mer du Nord risquent le plus de découvrir des munitions immergées

Les pêcheurs de la partie méridionale de la mer du Nord sont les plus susceptibles de découvrir des munitions, et il est fort probable que celles-ci soient conventionnelles, selon les informations disponibles. Ce type de notification permet aux autorités de centrer leurs efforts sur des zones dans lesquelles le risque d'anciennes immersions de munitions est le plus élevé. Il s'agit par exemple de pêcheurs qui prennent part à des opérations de chalutage de fond dans la partie méridionale de la mer du Nord. A cette fin, on considère comme bonne pratique, la création de lignes directrices, à l'intention des pêcheurs, sur la marche à suivre en cas de découverte de munitions et la mise à leur disposition de bouées de signalisation sous-marines.

Produits chimiques libérés par les munitions risquant d'avoir des impacts négatifs sur les écosystèmes marins

Il est possible pour les substances dangereuses libérées, aussi bien par les munitions chimiques que conventionnelles, d'avoir des effets négatifs sur le milieu marin et de pénétrer la chaîne alimentaire. On ne dispose, à ce jour, d'aucune preuve dans ce sens, cependant le taux en hausse de la corrosion de l'enveloppe métallique risque éventuellement d'entraîner des impacts à l'avenir. Les explosions liées aux munitions immergées risquent d'affecter les espèces marines. Les mammifères marins ou le poisson peuvent être blessés ou même tués par l'onde de choc et la forte pression exercée par le son à la suite d'une explosion. Le marsouin peut être tué dans un rayon de quatre kilomètres de grandes explosions et son ouie peut être affectée de manière permanente dans un rayon de trente kilomètres.

Il est nécessaire d'obtenir plus de renseignements sur les munitions déjà immergées

Les connaissances s'améliorent mais les informations précises sur les quantités, l'état et l'emplacement actuel des munitions déjà immergées sont insuffisantes. Ceci rend difficile la gestion des munitions immergées et le nettoyage des sites marins d'immersion de munitions présente de sérieux risques en matière de sécurité. De nouvelles techniques utilisant une technologie de contrôle à distance semblent prometteuses mais ne sont pas largement utilisées actuellement. A la lumière de ceci, la gestion des risques provenant des munitions immergées devra être envisagée lors de la planification et de la gestion de toutes les activités marines pertinentes. Les Parties contractantes OSPAR devront poursuivre la notification des contacts avec des munitions et des sites d'immersion et envisager de passer d'une notification réalisée tous les trois ans, à une notification réalisée tous les ans, dans le cadre de la Recommandation 2003/2. OSPAR devra également envisager des options pour la promotion de la recherche et de la surveillance des effets possibles des munitions immergées sur le milieu marin de l'Atlantique du Nord-est.

1. Introduction

This assessment is part of a series of assessments of the impact of human activities on the marine environment of the OSPAR area and has been prepared under the 2003 OSPAR Joint Assessment and Monitoring Programme as a contribution to the Quality Status Report 2010.

Dumping of chemical weapons and munitions has taken place since the end of the First World War and considerable amounts were dumped in the OSPAR Convention Area. At the end of the Second World War, there was in the United Kingdom in excess of 1 200 000 tonnes of surplus ammunition and bombs. The safest disposal method, adopted by most nations at the time, was dumping at sea (Bowles, 2006). Although in some cases the location and type of munitions dumped is well known, the full extent of munitions dumped in the OSPAR area will never be known. This is due mainly to inadequate documentation of operations at the time of dumping and the subsequent loss or destruction of records. The dumping of material outside agreed official dumping areas and the movement of dumped munitions, both in the water column immediately after dumping and relocation on the seabed through natural processes and fishing activities, cause further difficulties in establishing the locations of dumped munitions (Beddington and Kinloch, 2005). An example of the difficulties encountered is the Beaufort's Dyke dumpsite in the Irish Sea between Scotland and Northern Ireland, where medium to high densities of dumped munitions and munitions-related materials were confirmed in the area adjacent to the north-east sector of the chartered disposal area (FRS, 1996).

2. Concerns relating to dumped munitions

Information on the location and type of munitions dumped in the Convention Area was supplied by Contracting Parties and published by OSPAR (2005). The report identified over 140 dumpsites throughout the Convention Area and this is believed to be the best information available (Figure 2.1). One of the major difficulties in managing the risks associated with munitions dumpsites, highlighted in a number of reports (HELCOM, 1994 and FRS, 1996), is the uncertainty associated with their locations. Figure 2.1 shows that, in general terms, the distribution of known conventional munitions dumpsites tends to be in inshore waters whereas chemical weapons were dumped further offshore.

Dumping operations included dumping overboard from vessels and by sinking ships containing conventional and chemical weapons (OSPAR, 2004a). Best estimates suggest that in excess of one million tonnes of munitions were dumped in the Beaufort's Dyke, some 168 000 tonnes of ammunition were dumped in the Skagerrak (OSPAR, 2005), some 300 000 tonnes of munitions of various types such as bombs, grenades, torpedoes and mines were dumped in the North Sea (RWS, 2007) and an estimated 35 000 tonnes were dumped off Knokke-Heist, Belgium (OSTC, 2002). The materials dumped range from conventional munitions to phosphorus incendiary devices to chemical munitions containing mustard gases and other substances. Detailed information on the appearance and types of chemical munitions is given in the OSPAR framework for developing national guidelines for fishermen on how to deal with encountered conventional and chemical munitions (OSPAR, 2004a).

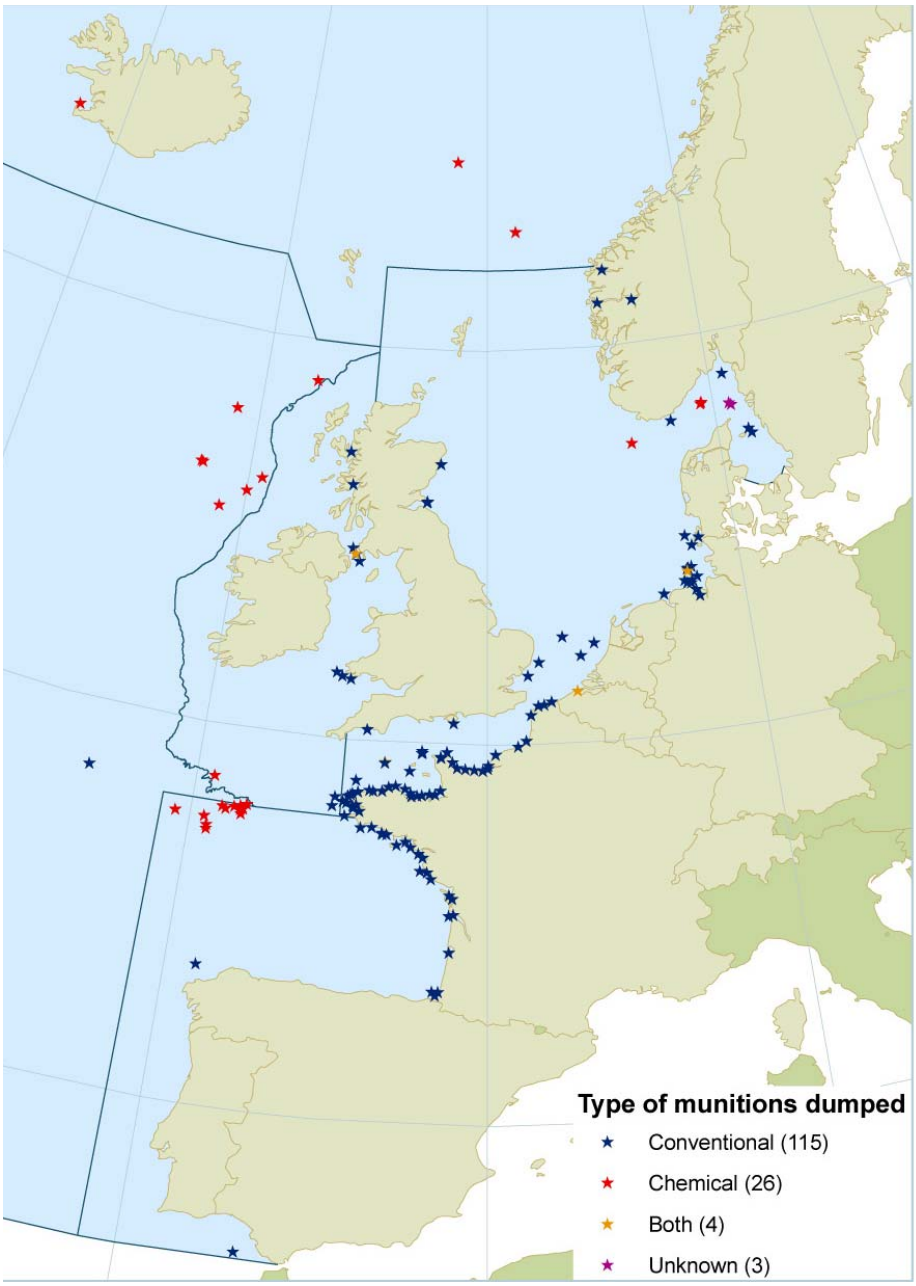


***Figure 2.1**: Location of known munitions dumping sites and type of munitions dumped*

Of particular concern is the possible consequence of contact with chemical warfare agents. Marine dumped chemical munitions react differently in water depending on the agent or agents they contain. The munitions shell may break open during the dumping operation or may corrode over time, allowing the agents to leak out. For example, the water-soluble nerve agent Tabun, a clear, colourless, tasteless liquid with a faint fruity odour originally developed as a pesticide but with more potent toxic effects (CDC, 2008), and many other chemical warfare agents would be rapidly mixed with seawater and diluted, thus having a very short-term effect. However, certain types of thickened mustard gas[1] that are insoluble in water could remain on the seabed for a very long time and injuries could occur as a result of contact with them. Simply touching chemical agents or inhaling the vapours is extremely

[1] Mustard gas, also known as sulphur mustard, can be a vapour, an oily-textured liquid or a solid. In its pure form it is a transparent, slightly volatile, oily substance with a sweet smell. The smell is very similar to cress, horseradish or mustard. Mustard gas normally occurs with impurities which give it a brown colour.

dangerous and it is important to have in place procedures for dealing with munitions when encountered. The OSPAR Commission has provided advice on developing national guidelines for fishermen on how to deal with encountered conventional and chemical munitions (OSPAR, 2004a).

Planned explosions during the laying of pipelines close to dumped munitions can initiate further detonations. There are concerns that seismic pulses have the potential to damage the thin skin or container of chemical munitions thus increasing the number of chemical releases in an area at one time. There is evidence that due to chemical reactions certain explosives that have been dumped may become more unstable and sensitive to shocks and are even more dangerous to deal with than the original substance (Long, 2005). A recent report from the British Geological Survey confirms that conventional munitions undergo spontaneous detonation on the seabed and spontaneous explosions, or explosions for which there are no known reasons, occur in the vicinity of munitions dumpsites (BGS, 2005). The consequences of such spontaneous explosions depend on factors such as the size of the explosion, proximity to: other dumped conventional and chemical munitions; sensitive species and habitats; infrastructure such as cables, pipes, offshore platforms and wind farms; and passing vessels. Explosions associated with dumped munitions may affect marine fauna. Marine mammals and fish can be hurt or even killed by the shock wave and the high sound pressure following an explosion. Harbour porpoises can be killed within four kilometres of large explosions and their hearing can suffer permanent damage as far away as 30 kilometres (NABU, 2007).

According to Beddington and Kinloch (2005), there are three basic types of danger that munitions dumped at sea can cause:

(i) direct physical contact with either chemical or conventional munitions resulting in threats to human health;

(ii) contamination of marine organisms and the environment in the vicinity of dumped munitions and the consequent potential for some concentration of toxic contaminants entering the wildlife and human food chains;

(iii) spontaneous explosions which can be directly life threatening, but also have the potential to spread material away from the dump sites thereby increasing the potential for more of it to come into direct physical contact with individuals.

Direct physical contact or disturbance of munitions can occur with various marine activities for example fishing, laying cables and pipes, sand and gravel extraction and diving. Encounters associated with each of these activities have been reported by Contracting Parties to OSPAR, but the majority of encounters, 59% of all reported, were associated with fishing activities.

Quality assured data on persistence, bioaccumulation and toxicity for chemical and conventional warfare agents dumped in the marine environment is lacking (Beddington and Kinloch, 2005). Without these data and, on a case by case basis, detailed information on the precise location of munitions, the condition of the casings and the active chemical and/or explosive components, a detailed environmental assessment of the actual or potential impact of past dumped munitions is not possible. One of the most comprehensive studies carried out on a dumpsite was completed in 1996 on Beaufort's Dyke (FRS, 1996). This showed no evidence of munitions related chemicals in sediments, fish or shellfish. Associated naturally occurring substances such as arsenic and heavy metals were within the range occurring in samples from areas around the United Kingdom.

With the entry into force of the Oslo Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft in 1974, the dumping of munitions ceased in the Convention Area. The vast majority of munitions were dumped immediately after World War II and the problem of dumped munitions is an inherited one. With the passing of time, munitions are disintegrating on or in the seabed and the majority of warfare agents are degrading or dispersing, thus reducing the potential to

cause damage. However, with the increasing demand on marine services and space, relatively new activities such as offshore wind farms and changes in fishing practices could disturb hitherto undisturbed munitions and alter this gradual process resulting in increased environmental and/or safety risks. It is essential therefore that all marine related activities consider the potential risks from dumped conventional and chemical munitions. The location of known dumpsites can assist this process and activities planned in, or close to, such dumpsites should be subject to a dumped munitions risk assessment.

Beddington and Kinloch (2005), in reviewing the literature on the key question as to whether to leave munitions dumpsites undisturbed or to carry out remedial work on them, stated that the literature overwhelmingly recommends that munitions dumpsites, both chemical and conventional, should remain undisturbed (FRS, 1996). However, ongoing developments using remote control techniques to manipulate munitions underwater, UV treatment to neutralise warfare agents and using bubble curtains to minimise the effects of explosions are showing promise (NABU, 2007).

3. Measures taken by OSPAR

The QSR 2000 recognised that marine dumped munitions present a hazard to the public and that OSPAR was considering a course of action for dealing with dumped munitions (OSPAR, 2000). One of the first steps taken by OSPAR was to collect information on the procedures in place by Contracting Parties in relation to marine dumped chemical weapons and munitions. To this end a questionnaire was circulated to Contracting Parties, Non-Governmental Organisations and Observers to gather information on reporting of encounters, on guidance issued to fishermen and users of the sea and on existing surveillance and management practices.

The results of this exercise (OSPAR, 2004b), showed that:

- Although there are systems in place in most countries to record encounters with dumped chemical weapons and munitions, such records are not centrally maintained and/or easily accessible.
- The information contained in guidelines produced by Contracting Parties for fishermen and other users of the sea varies considerably between countries. In order to ensure that sufficient information is available to fishermen who may encounter dumped chemical weapons and munitions the preparation of draft OSPAR guidelines was considered.
- Given the number of dumpsites recorded in the OSPAR overview of dumped weapons (OSPAR, 2005), there has been relatively little monitoring to date. Where monitoring has taken place, the need for further monitoring has been identified. The requirement for further site assessments and ongoing monitoring may need to be considered by Contracting Parties.
- There is no specific protocol available to assess the risks associated with activities in the vicinity of dumpsites.
- Recovery of dumped munitions is a costly and highly risky operation which could result in the release of toxic material into the environment, and the majority of scientific opinion is that munitions on the seabed present no risk to human health or the marine environment if they are left undisturbed.

In recognition of the deficiencies in available information on the locations of marine munitions and chemical weapons dumpsites and in the recording of encounters with munitions and chemical weapons, the OSPAR Commission published ‘OSPAR Framework for reporting encounters with

marine dumped chemical weapons and munitions' in 2003 (OSPAR, 2003a). The ongoing recording and reporting of encounters was seen as a possible way of identifying previously unknown or unrecorded dumpsites and also of identifying changes in the condition of dumped material or of the dumpsite following natural and anthropogenic disturbances. This information could be used to adjust the boundaries of known dumpsites or to identify new dumpsites or areas of high risk on marine charts. This activity is also consistent with the Decision No 2850/2000/EC of the European Parliament and of the Council of 20 December 2000 setting up a Community framework for cooperation in the field of accidental or deliberate marine pollution (2850/2000/EC).

The preparation of these publications heightened the awareness amongst Contracting Parties that a coordinated OSPAR-wide approach would have added value in increasing our understanding of the extent and impact of past dumped chemical weapons and munitions in the entire Convention Area. In parallel to the collection of data and information from Contracting Parties and the preparation of the reports, OSPAR adopted Recommendation 2003/2 on an OSPAR Framework for reporting encounters with marine dumped conventional and chemical munitions. This Recommendation entered into force on 2 July 2004. The reporting deadlines under Recommendation 2003/2 were set for 1 September 2005 and every three years thereafter. Contracting Parties were encouraged to report clusters of encounters as soon as such clusters became evident. The first implementation report, consisting of reports of encounters as well as a short description of the systems in place, was published by OSPAR in 2007 (OSPAR, 2007) and the first JAMP assessment on encounters reported by Contracting Parties for the period 2004 - 2005 was published in 2008 (OSPAR, 2008). A considerable number of additional encounters were reported for the period up to the end of 2008 and this report updates the first JAMP assessment to include these new data.

While acknowledging that some Contracting Parties already have national guidance, OSPAR published 'A framework for developing national guidelines for fishermen on how to deal with encounters with conventional and chemical munitions' in 2004 (OSPAR, 2004a). This intended to provide background information on the following topics:

- Areas at risk, *i.e.* the location of conventional and chemical munitions dumpsites in the North-East Atlantic.
- General description of munitions.
- Description of chemical agents, their effects and first-aid treatment.
- What to do in the event of an encounter.

4. Reporting and assessment of encounters within the OSPAR region

OSPAR agreed in 1998, and reflected this in the QSR 2000, to consider how it might address the issue of dumped chemical weapons and munitions in the Convention Area. While work on dumped chemical weapons was ongoing in HELCOM with the establishment of an ad hoc Working Group on Chemical Munitions in 1993 and the production of a final report in 1995 (HELCOM, 1995), this was the first time OSPAR considered this issue. As outlined above, OSPAR published the following reports all of which are available on the OSPAR website (www.ospar.org):

- OSPAR Framework for reporting encounters with marine dumped chemical weapons and munitions. Publication number 186/2003.

- Overview of past dumping at sea of chemical weapons and munitions in the OSPAR maritime area first in 2004 and updated in 2005. (Figure 2.1 is believed to be the best information available on the location and type of chemical weapon and munitions dumpsites for the Convention Area.) Publication number 222/2005.
- Convention-wide practices and procedures in relation to marine dumped chemical weapons and munitions. Publication number 185/2004.
- A framework for developing national guidelines for fishermen on how to deal with encounters with conventional and chemical munitions. Agreement 2004-9.
- Recommendation 2003/2 on an OSPAR Framework for reporting encounters with marine dumped conventional and chemical munitions.
- Implementation of OSPAR Recommendation 2003/2 Database on encounters with dumped conventional and chemical munitions. Publication number 267/2007.

Since the publication of the first edition of this assessment covering the period 2004 and 2005 a significant number of additional encounters were reported. In some cases, the same encounter was reported by two, or even three, Contracting Parties. To avoid including multiple reporting of the same encounter in the assessment, encounters occurring on the same date and within 2km of each other but reported by different Contracting Parties were removed from the data set.

After the removal of multiple reports, a total of 1879 encounters were reported by Belgium, France, Germany, Ireland, the Netherlands, Spain, Sweden and the United Kingdom. Denmark and Norway recorded no encounters with dumped munitions. The data used in this assessment are from the OSPAR database on encounters with marine dumped conventional and chemical munitions (OSPAR, 2009).

Encounters were reported over the period April 1999 to October 2008. This extends outside the reporting period required by Recommendation 2003/2 and some Contracting Parties may have additional records of encounters within this extended period that have not been reported. However, with the exception of multiple reportings, all reported munitions encounters are considered here. In taking this approach temporal and spatial distribution of encounters throughout the OSPAR maritime area will, to some degree, reflect the nature of reporting by different Contracting Parties. However, by including encounters reported outside the reporting period, it is a reasonable assumption that the distributions presented will better represent the real world situation.

The temporal distribution of encounters reported by Contracting Parties is shown in Figure 4.1. An increase in reporting during 2004 as a result of the coming into force of Recommendation 2003/2 is noticeable. A second, even larger increase during the months of April and May 2005, coincides with a tragic incident on 6 April 2005 in which three Dutch fishermen lost their lives when a World War II bomb exploded on board their fishing vessel after having been hauled aboard in fishing nets.

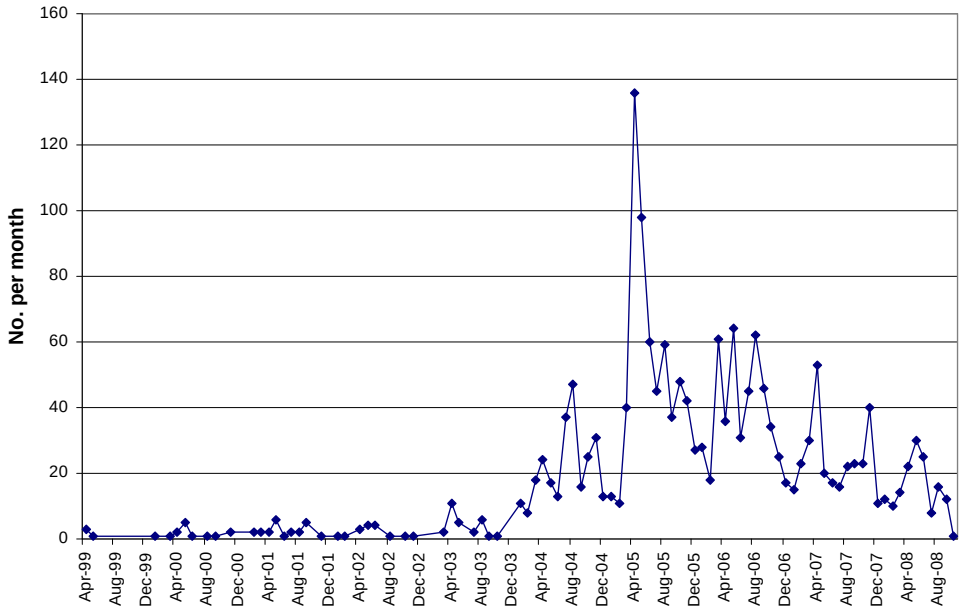


***Figure 4.1**: Number of reported encounters with conventional and chemical munitions within the OSPAR Convention Area for the period 1999 to 2008*

Of the 1879 munitions encounters reported, 1595 (85%) were described as conventional, 30 (2%) as chemical and 254 (14%) were of unknown type. In this report, phosphorus devices are taken to be conventional munitions. The devices encountered on 786 occasions (42%) were reported to be in various stages of corrosion, from partly to completely corroded, 14 (1%) were described as being live or in good condition and the state of the remainder were unknown or not reported.

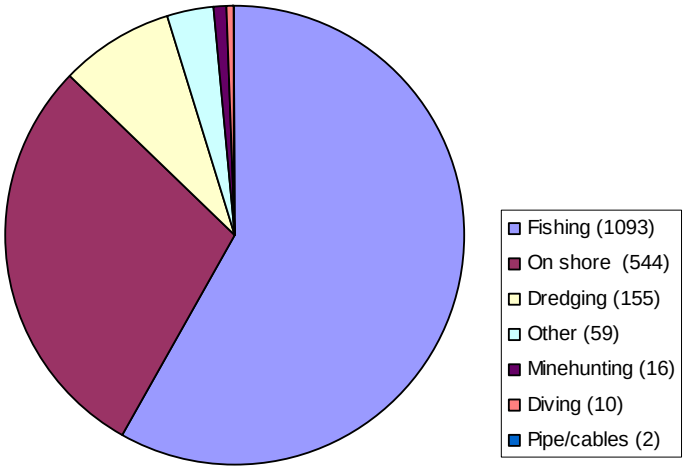


***Figure 4.2**: The nature or description of activity taking place when encounters occurred. The number of encounters in each category is shown in brackets*

The majority of encounters, 1093 (58%), were entangled in nets during fishing activities, 544 (29%) were found on the shore, 155 (8%) were encountered during dredging activities and 59 (3%) were encountered during non specific activities. Minehunting, diving and laying pipes and cables accounted for the remaining 2% (Figure 4.2). Specific information submitted on the activities taking place ranged

from children digging on the beach to spent shell heads discovered being used as ballast on a vessel under repair.

Contracting Parties are required to report on the action taken as a result of the encounters with munitions. Of the 1879 occasions when encounters were reported, the devices encountered were destroyed on 1141 occasions and disposed of on land in a further 295 occasions. This equates to the devices being neutralised on over 76% of the recorded encounters. On 202 occasions (11%) the devices were released at sea and the location of the release was recorded on all occasions except five. Not surprisingly, of the 202 occasions when munitions were released at sea, the vast majority (97%) were encountered during fishing.

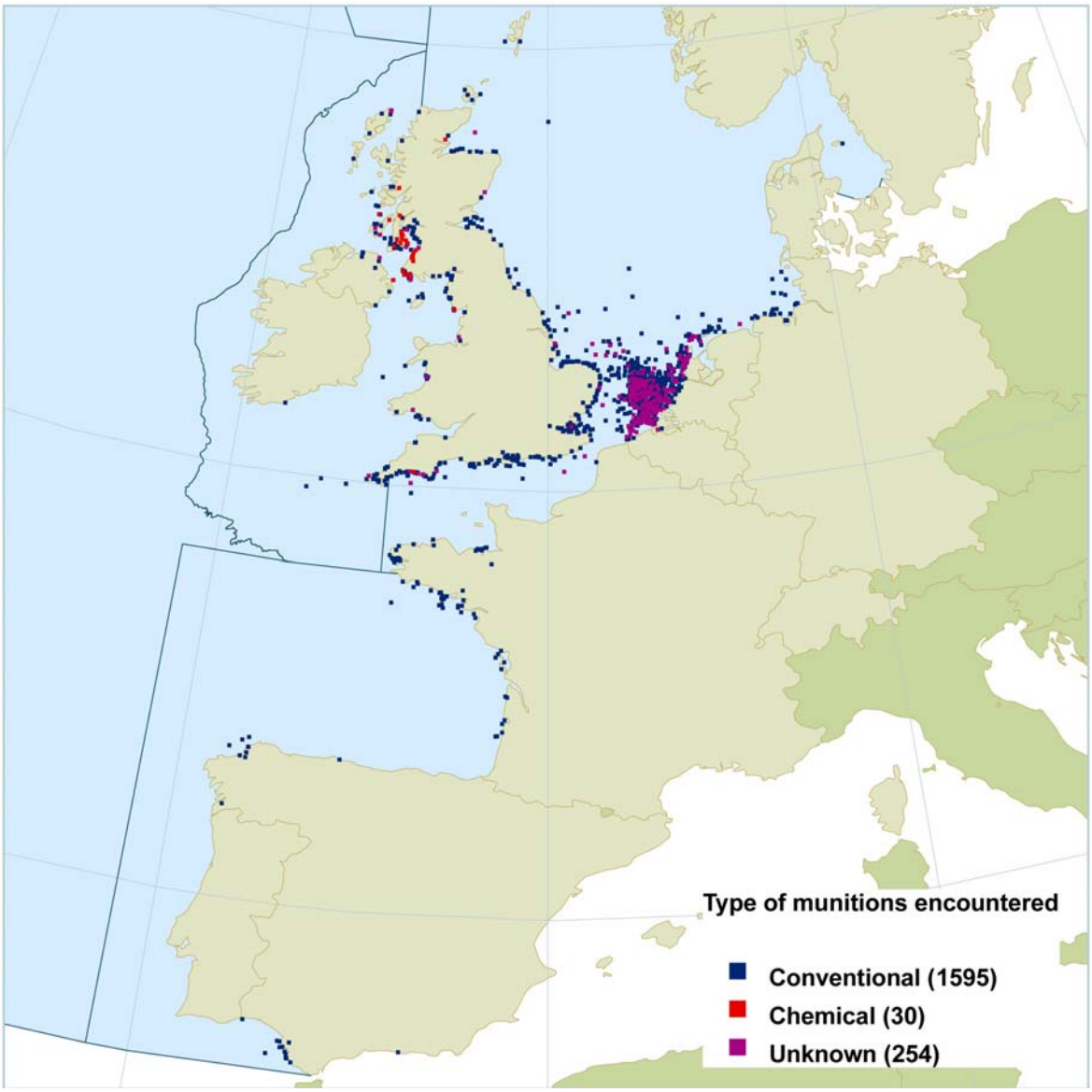


***Figure 4.3**: Location of encounters for which coordinates were reported by Contracting Parties. Number of encounters in brackets*

Since not all Contracting Parties reported encounters over the time period required under Recommendation 2003/2, and others provided data for periods outside the reporting period, a detailed spatial and temporal analysis of encounters with munitions is difficult. Multiple reporting of the same encounter further complicated this. Reliable coordinates are available for 1821 of the 1879 encounters reported and only these encounters can be plotted. The distribution of reported munitions encounters

throughout the OSPAR area is plotted against the distribution of known dumpsites reported to OSPAR (see Figure 4.3). No clear relationship between the location of known dumpsites and munitions encounters emerged from the data submitted. Of the 1821 encounters with known locations, 7% were located within 5 km of reported dumpsites, whereas 31% of encounters occurred at a distance greater than 50 km and 5% of encounters occurred more than 100 km away from known dumpsites.

The density of encounters reported is represented in Figure 4.4 and shows that the area with the highest density of encounters reported is the southern North Sea between the United Kingdom and the Netherlands. The second area where encounters are most frequently reported is west of Den Helder in the Netherlands where 92 encounters were reported. Other areas of medium frequency are the Moray Firth, the Firth of Forth and Firth of Tay in the north-east of the United Kingdom, the Firth of Clyde on the north-west and along the south and south-east coast of the United Kingdom. The Belgian, Dutch and German coasts, and the coast of Brittany in France also encounter munitions at medium frequency.

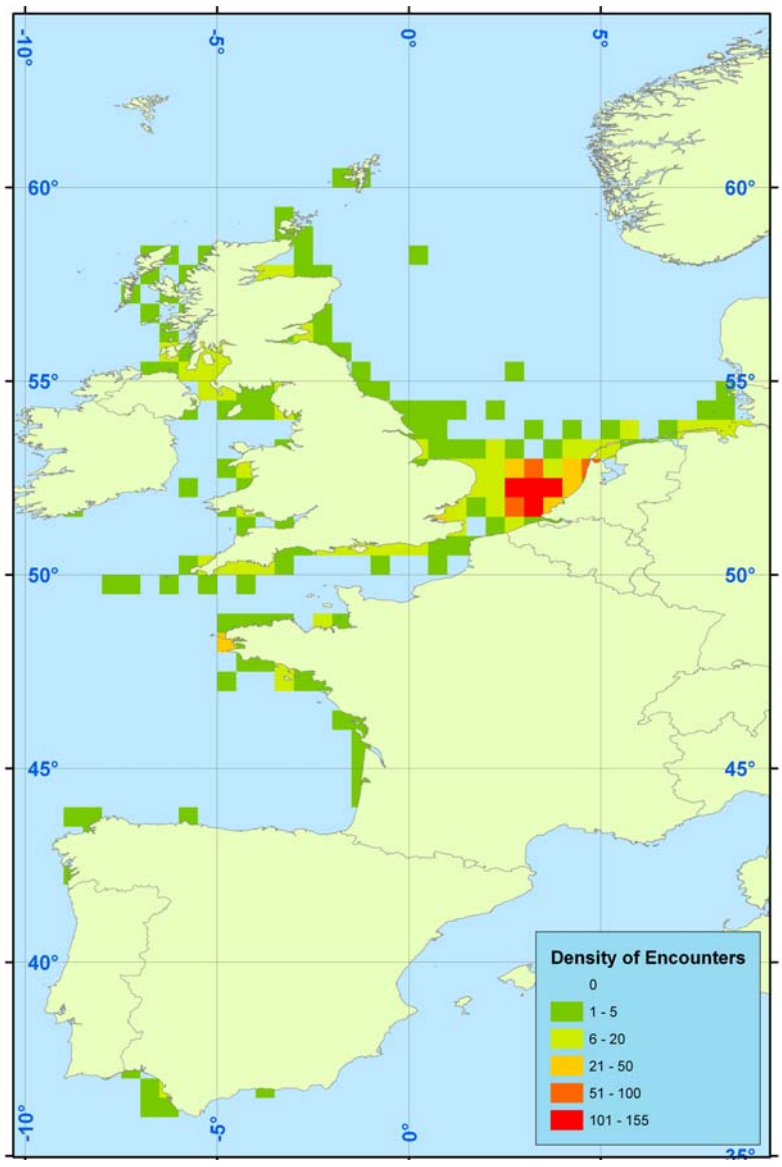


***Figure 4.4**: Density of encounters reported*

For those reported encounters for which reliable coordinates are available, the different activities being undertaken when the encounter took place is shown in Figure 4.5a. The data shows that encounters on the shore are most frequent around the coast of the United Kingdom, Germany and, to a lesser extent, the coasts of France and Spain. Of the 1821 encounters plotted, approximately 1320 (72%) were located within the southern part of the North Sea between the United Kingdom and Belgium, the Netherlands, and Germany. The encounters west of Den Helder are predominantly associated with dredging activities and the offshore encounters in the southern North Sea are almost exclusively from fishing activities (Figure 4.5b).

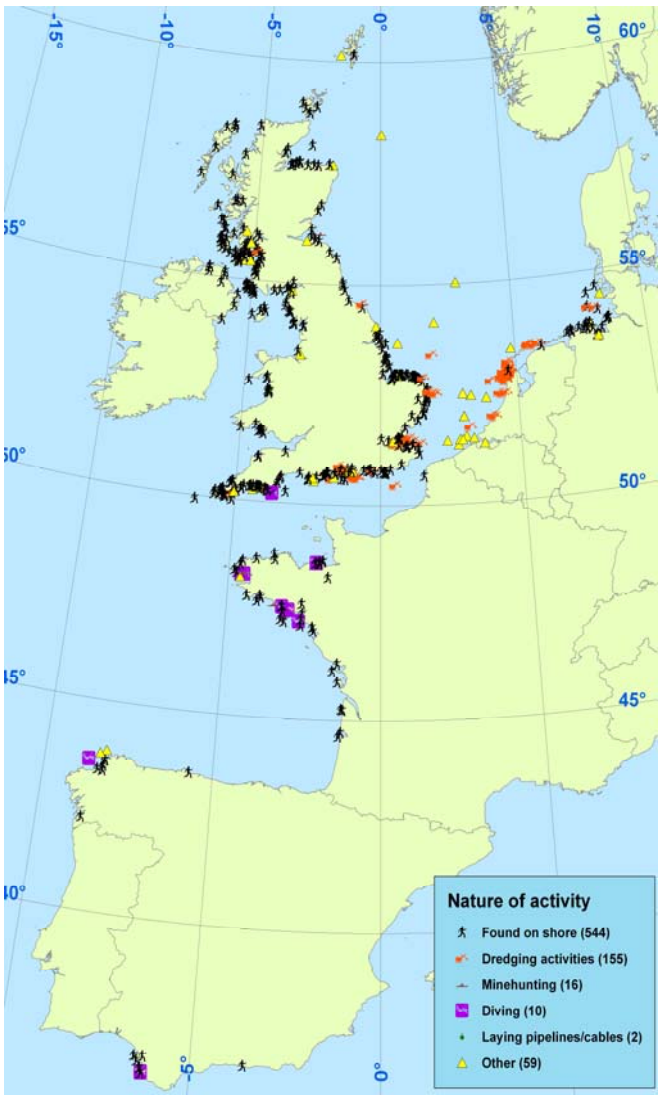


***Figure 4.5a**: Location and nature of encounters, other than fishing, for which coordinates were reported by Contracting Parties. Number of encounters in brackets.*

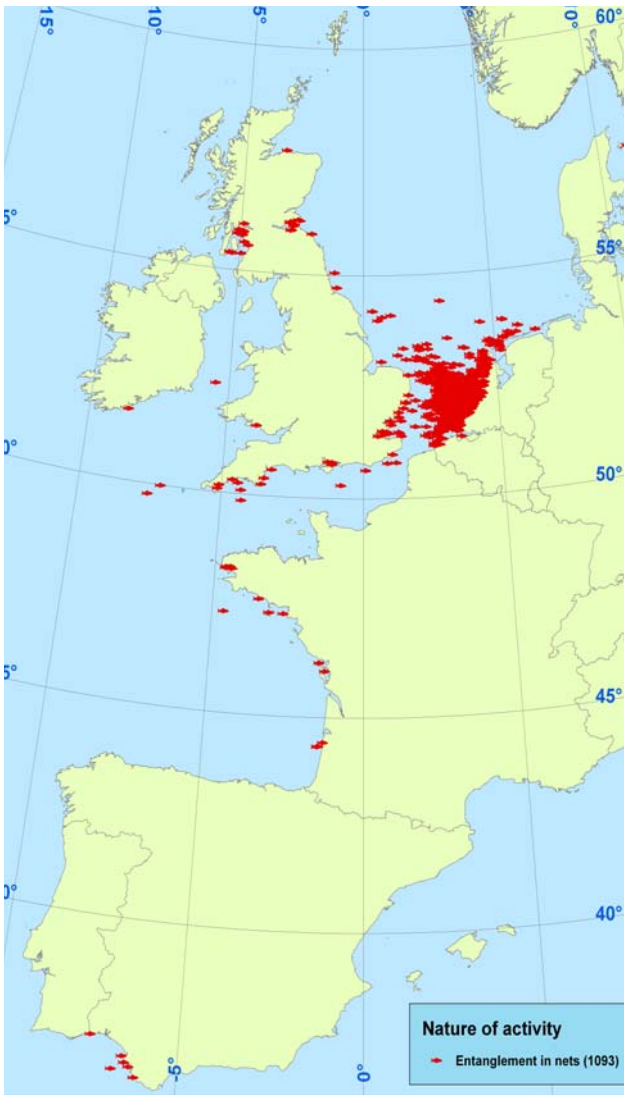


***Figure 4.5b**: Location of encounters by fishermen for which coordinates were reported by Contracting Parties. Number of encounters in brackets.*

Based on the data presented and assessed here, there is no obvious association between the location of encounters and known dumpsites. Analyses suggest that one-off encounters are very common as 31% of encounters occurred at distances of 50 km or more from known dumpsites. Bottom trawling in the southern North Sea and dredging west of Den Helder are the activities most likely to encounter dumped munitions in the OSPAR maritime area (Figure 4.6). There could be many reasons for this, including the location of the Contracting Parties that reported data on munitions encounters, the level and type of fishing activity, the nature of the seabed and water depth as well as historical military operations and flight paths during World War II. However, the significant increase in encounters reported after the death of the Dutch fishermen in April 2005 suggests that the distribution pattern of reported encounters is influenced to a very large extent by the increased level of reporting by fishermen to the Dutch authorities.

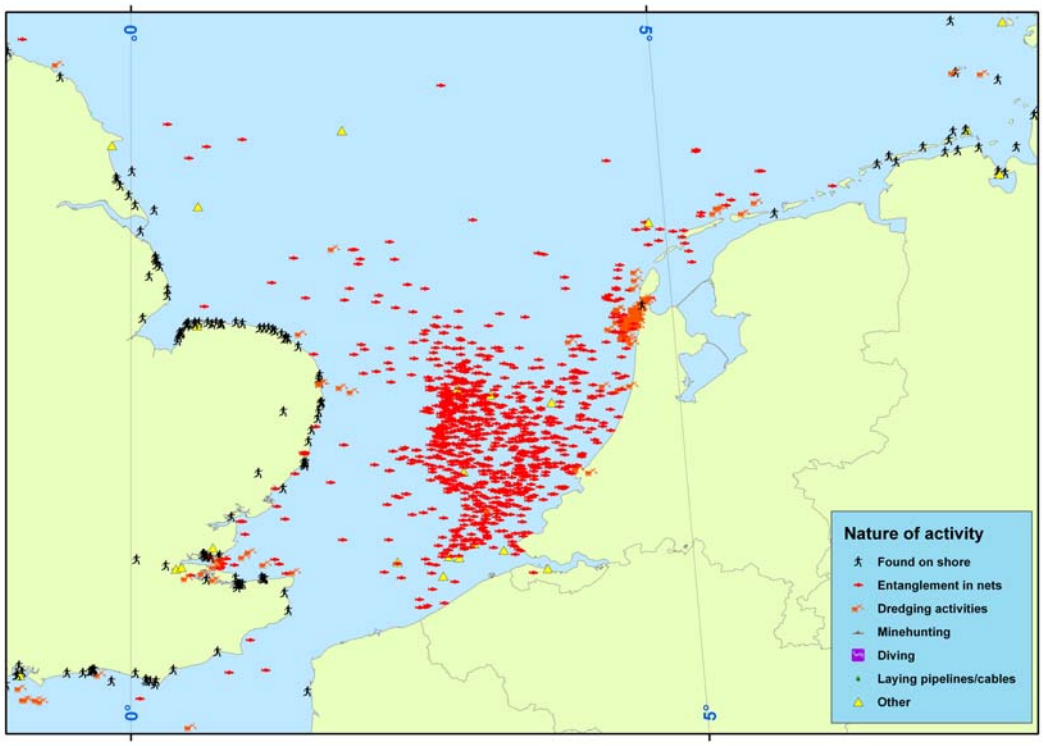
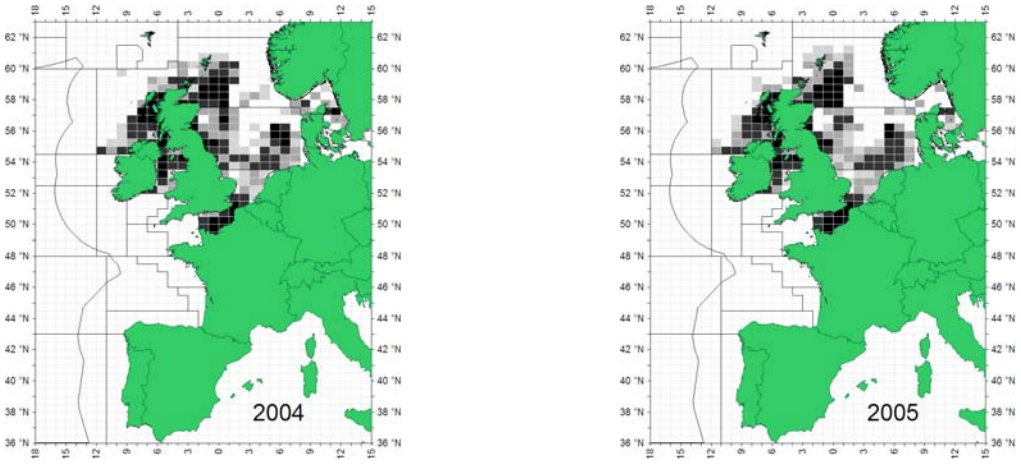
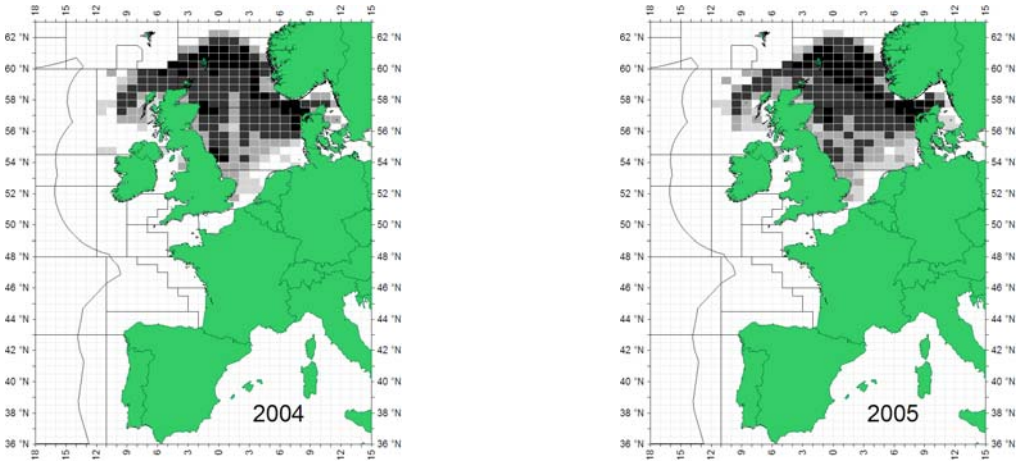


***Figure 4.6**: Location and nature of encounters in the southern North Sea*

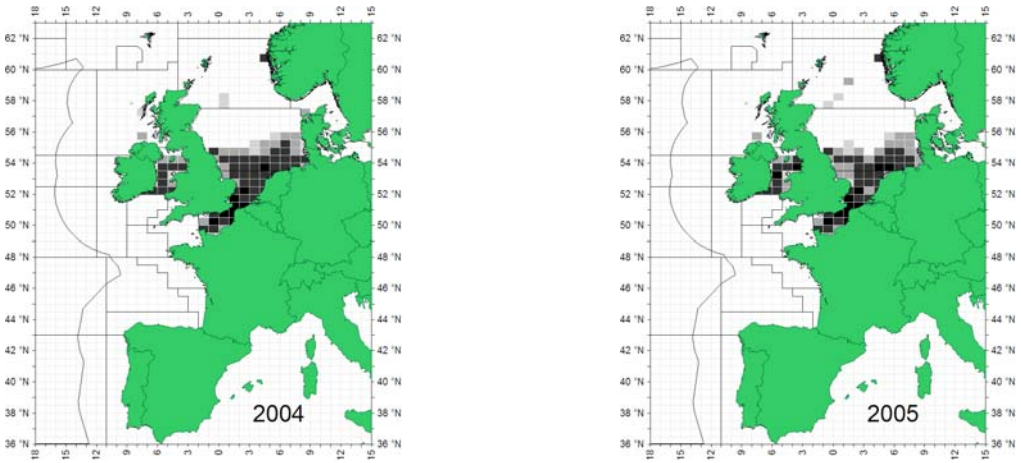
The spatial distribution pattern of bottom fishing effort in European waters (EC, 2007) is shown in Figure 4.7. This shows the distribution of effort, measured in trawled hours, of bottom trawls for vessels greater than 10 meters, for the period 2004 - 2005. The fishing effort of Dutch vessels is not included, however, according to the authors of the report, it should sufficiently reflect the geographical distribution of bottom fishing effort for the area in question. A visual comparison of the distribution of encounters reported and the bottom fishing effort suggests that there is no correlation between encounters reported and otter and seine trawling for 2004 and 2005. Beam trawl fishing activity for these years is predominantly focused on the southern North Sea but, in general, covers an area wider than the areas within which most of the munitions encounters were reported suggesting, at best, a weak correlation with bottom fishing effort.



Otter trawls and seines using mesh size between 70 and 98 mm for 2004 and 2005



Otter trawls and seines using mesh size ≥ 120mm for 2004 and 2005



Beam trawls using mesh sizes 80-89mm for 2004 and 2005

Figure 4.7: *Geographic distribution patterns of effective effort (trawled hours) of the otter trawls, seines and beam trawls for 2004 and 2005. Source: (EC, 2007)*

In addition to the information on dumpsites and encounters reported to OSPAR by Contracting Parties, the Ministry of Defence in the United Kingdom commissioned the British Geological Survey (BGS) to undertake an analysis of the underwater explosions recorded by the BGS seismograph network within 100 km of the Beaufort's Dyke munitions dumpsite in the north of the Irish Sea. Explosions have a

characteristic signature that allows them to be distinguished from natural events such as earthquakes. Using signals detected at a number of different seismographic stations, the BGS detected 47 underwater explosions in the Beaufort's Dyke area between 1992 and 2004 (BGS, 2005), (see Figure 4.8). These explosions do not strictly fall within the scope of OSPAR Recommendation 2003/2 and were not reported under that Recommendation. Over the period 2004 – 2005 there were five explosions detected by the BGS.

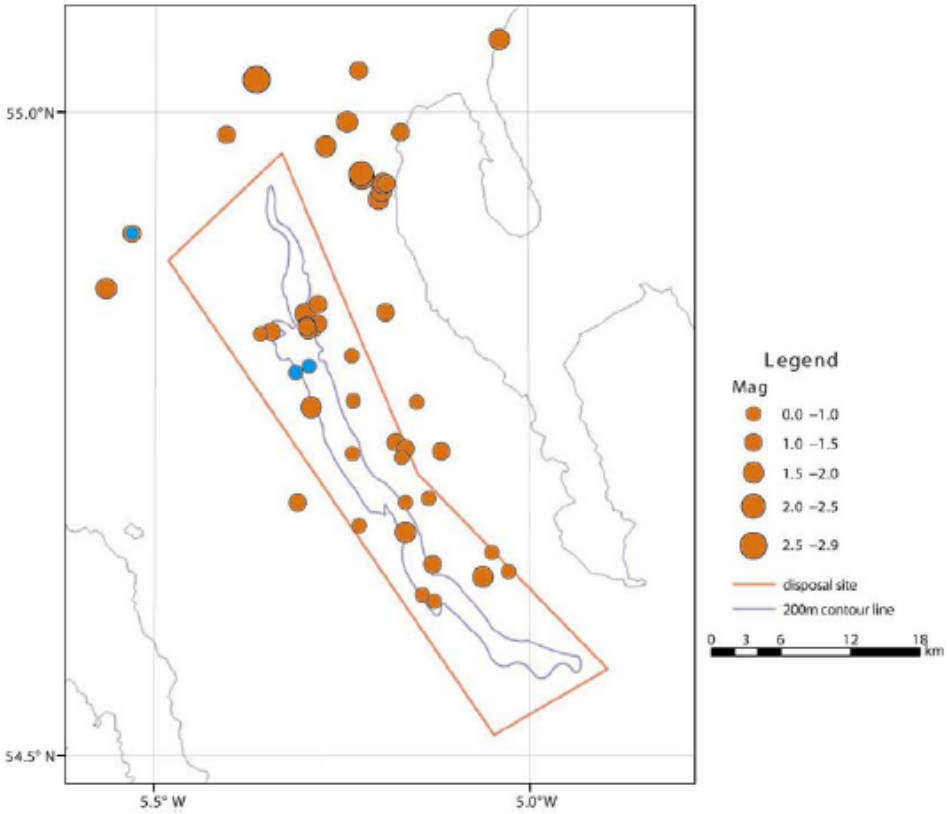


***Figure 4.8**: Locations and magnitude (Richter Scale ML) of underwater explosions in the Beaufort's Dyke area between 1992 and 2004 that were detected by the BGS seismograph network and are available in the BGS seismicity database. The blue circles show three explosive events identified during the BGS analyses that had not been previously attributed to the Beaufort's Dyke area. Source: BGS, 2005.*

5. Implications of dumped munitions

Unlike assessment of the impact of present day human activities, this assessment considers the impacts of historical activities that have ceased since the coming into force of the London Convention on the Disposal of Wastes at Sea and the Oslo Convention for the Prevention of Marine Pollution in the North-East Atlantic in the 1970s.

According to the HELCOM Working Group on Dumped chemical munitions in the Baltic the consensus of scientific opinion is that munitions on the seabed present no risk to human health or the marine environment if they are left undisturbed and, based on available information, a widespread risk to the marine environment from dissolved warfare agents can be ruled out. This Group recommended further work to be carried out on the ecotoxicology of chemical agents, especially mustard gas, chlorinated additives and arsenic compounds.

Based on the information available there is a clear risk to marine users in many parts of the OSPAR Convention Area, in particular to fishermen in the southern North Sea. Guidelines to fishermen are therefore very important and should be updated when new information becomes available. There are serious safety issues relating to dumped munitions and the best management practice is, where possible, to leave munitions on the seabed and allow them to disintegrate naturally. Because human activities such as fishing and dredging result in encounters with dumped munitions, it is difficult to comment on the effect dumped conventional and chemical munitions have on the quality status of the OSPAR Area without considering the activities that may disturb such munitions.

Direct environmental measurements for the constituents of conventional and chemical warfare agents are very limited. The Beaufort's Dyke study showed that no traces of such agents were detected in sediments, fish or shellfish collected in or around the charted munitions dumpsite and that levels of metals in sediments, fish and shellfish were within expected background ranges (FRS, 1996).

The detailed review of dumped munitions by Beddington and Kinloch (2005) concluded that the evidence to date does not indicate that there have been significant ecological effects generated from TNT-based munitions. However, this could be due to slow corrosion rate of the strengthened steel casings used for these types of munitions. The authors further state that there is a possibility of both chemical and conventional munitions entering the food chain but that there is no evidence to indicate that this has occurred (Beddington and Kinloch, 2005).

6. Recommendations for future management of munitions encounters

As a result of the work undertaken within the OSPAR framework there has been a significant improvement in our knowledge with respect to the distribution of historical conventional and chemical munitions dumpsites. OSPAR should continue to compile information on known dumpsites and update the OSPAR database and map of munitions dumpsites.

The reporting of encounters with munitions under Recommendation 2003/2 is proving to be very useful in identifying the location of munitions, the activities at most risk of encountering dumped munitions, the current state of dumped munitions, and the follow-up actions taken by the various Contracting Parties' authorities. It is also a very useful mechanism for the exchange of information.

Following the tragedy on the Dutch fishing boat in April 2005, the Dutch authorities developed a new subsurface buoy and sonar reflector to reduce the risk of the marker being damaged by vessels (see Figure 6.1). Fishermen are requested to carefully attach the sonar reflector to any unexploded objects before replacing them back into the sea. This device is reusable and 500 were supplied to the Dutch fishing fleet. Consideration should be given to supplying these marker devices to boats fishing in areas where there is a significant risk of encounters with munitions. In addition, these boats should be targeted for circulation with relevant information and guidelines.

The decision to permit marine based activities such as sand and gravel extraction, pipe and cable laying and wind farm construction should be informed by information about the location of known dumpsites and the density of munitions encounters. Where appropriate, risk assessments should be carried out.

The use of seismograph networks is potentially a very useful tool to monitor underwater explosions of munitions. The resolution reported for the epicentre using this technique is in the order of 5 km and could detect clusters in both time and space. This technique should be further evaluated and

consideration be given to including the results of such monitoring in the encounters database under OSPAR Recommendation 2003/2.

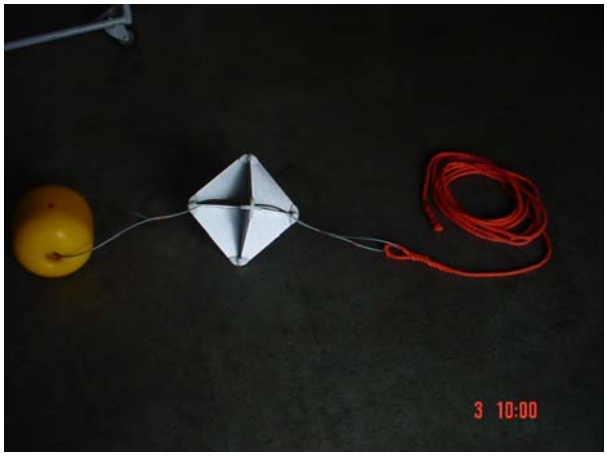


***Figure 6.1**: Buoy and sonar reflector for marking munitions before being released back into the sea. Source: The North Sea Directorate, the Netherlands*

Where the return to sea of encountered munitions is unavoidable, they should be adequately marked, with markers such as a sonar reflector, so that they can be readily recovered and neutralised. It is essential that the cycle of catch and release is broken and that the 11% released to sea is further reduced.

OSPAR should continue reporting on munitions encounters and dumpsites and consider changing the regular reporting under Recommendation 2003/2 every three years to annual reporting. OSPAR should also consider options for promoting research and monitoring of possible effects of dumped munitions on the marine environment of the North-East Atlantic. Developments in the field of new remote controlled UV cleanup technology and noise mitigating measures will be reviewed periodically and identified as potential munitions management techniques as appropriate.

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OSPAR's vision is of a clean, healthy and biologically diverse North-East Atlantic used sustainably

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