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Introduction to Part II: National Case Studies

Angela Carpenter¹ and Andrey Kostianoy²

Abstract

This book (Part 2 of a volume on “Oil Pollution in the Mediterranean Sea”) presents a review of knowledge on oil pollution in the Mediterranean Sea, through a series of National and Regional Case Studies. Making use of a range of data on oil extraction and production activities, oil transportation, satellite technology, aerial surveillance, in-situ monitoring, oil-spill sampling and oil fingerprinting, for example, it presents a picture of trends in oil pollution in various areas of the region over many years. It examines national practices in a number of Mediterranean Sea states. A range of legislative measures are in place to protect the marine environment of the region. For example, the Mediterranean Sea and its various regions, such as the Adriatic Sea, have Special Status for the prevention of pollution by oil from ships under International Convention for the Prevention of Pollution from Ships and its Protocols (MARPOL 73/78 Convention). At the same time the Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention, 1976) and its various protocols provide a legislative framework under which countries in the region can work together to cooperate in preventing pollution from ships, for example, and work together to combat pollution in the event of an emergency. National contingency planning and oil pollution preparedness and response activities, and the work of the Regional Marine Pollution Emergency Centre (REMPEC) for the Barcelona Convention’s contracting parties are also discussed within various national case studies. This book brings together the work of scientists, legal and policy experts, academic researchers and specialists in various fields relating to marine environmental protection, satellite monitoring, oil pollution and the Mediterranean Sea.

Keywords

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Mediterranean Sea, oil pollution, European Union, Barcelona Convention, MARPOL Convention, REMPEC, National contingency plan, Oil Pollution Preparedness and Response, aerial surveillance, oil spill monitoring, satellite monitoring, shipping, oil installations.

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The Mediterranean Sea is bounded by the coasts of Europe, Africa and Asia, from the Strait of Gibraltar in the west to the entrances to the Dardanelles and the Suez Canal in the east [1]. It covers an area of approximately 2.5 million km² and has an average water depth of 1.5 km with a maximum depth of just over 5 km [1]. The Mediterranean basin is approximately 4,000 km from east to west, and has a maximum width of 800 km [1].

The Mediterranean Sea is divided into two deep basins, the Western and Eastern Basins, and is further sub-divided into a number of sea areas. These are (from west to east): Alboran Sea; Balearic (Iberian Sea); Ligurian Sea; Tyrrhenian Sea; Ionian Sea; Adriatic Sea; and Aegean Sea (The Archipelago) [1]. The Mediterranean Sea also has eleven sub-basins, as outlined in Table 1.

Table 1 List of the eleven Mediterranean sub-basins

| Sub-basin | Bordering Countries |
|-----------------|--|
| Alboran | Spain, Morocco, Algeria |
| North-western | Spain, France, Monaco, Italy |
| South-western | Spain, Italy, Algeria, Tunisia |
| Tyrrhenian | Italy, France |
| Adriatic | Italy, Croatia, Albania (plus Montenegro, Slovenia, and Bosnia and Herzegovina*) |
| Ionian | Italy, Albania, Greece |
| Central | Italy, Tunisia, Libya, Malta |
| Aegean | Greece, Turkey |
| North-Levantine | Turkey, Cyprus, Syria, Lebanon |
| South-Levantine | Lebanon, Israel, Egypt, Libya |
| Marmara Sea | Turkey |

Adapted from [2, page 7]

* These states did not appear in the original table.

Travelling clockwise from the west at the Strait of Gibraltar (see **Figure 1**), the Mediterranean Sea is bounded by Spain, France, Monaco, Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Albania, Greece, Turkey, Syria, Lebanon, Israel, Egypt, Libya, Tunisia, Algeria and Morocco. Two island states located in the Mediterranean are Malta (south of Sicily) and Cyprus (which lies south of Turkey and west of Syria). The Gaza Strip, together with the British Overseas Territories of Gibraltar, and Akrotiri and Dhekelia, also have coastlines on the Mediterranean Sea.

Figure 1: Shaded Relief Map of the Mediterranean Sea



Source: Wikipedia Commons – Mediterranean Sea Relief Location Map [3]

The eastern Mediterranean Sea, and the east coast of Italy (in the Adriatic) is the location of the majority of oil and gas exploration and exploitation activities. In 2002 it was estimated that there was a reserve of around 50 billion barrels of oil and 8 trillion cubic meters of gas in the region (about 4% of world reserves) [2] and, in 2005, there were over 350 wells drilled for offshore production in the waters off Italy, Egypt, Greece, Libya, Tunisia and Spain [2] of which the majority were located along the Northern and Central Adriatic Coasts of Italy (around 90 of the 127 offshore platforms for the extraction of gas in Italian waters in 2007) [4].

In 2011, gas was discovered in what is the Leviathan gas field, 135 km off the coast of Israel, with an estimated volume of 16 trillion cubic feet of gas (approximately 453 million cubic meters) [5]. In August 2017 a contract was signed to drill two wells and complete four production wells in the Leviathan Field [6].

There have also, in the last decade, been significant exploration activities off the coast of Cyprus, following the development of new technologies to assess and reach previously inaccessible reserves, worth an estimated \$131 billion [7]. Most recently, the drilling of up to 25 new wells and installation of two new platforms were planned up to 2021 in the Prinos and Prinos North oil fields in the Gulf of Kavala offshore of northern Greece [8].

Oil and gas exploration and production activities pose a hazard to the marine environment in a number of ways, both during the exploration phase and the production phase. Environmental monitoring frameworks have been in place in some regions for many years, including in the North-East Atlantic Ocean / North Sea region under the OSPAR Convention [9], where a framework for environmental monitoring of oil and gas activities was established in 1999 [10] and where a range of ever more stringent emissions standards for discharges of oil in drilling fluids, cuttings, and produced water from installations in the region have developed since that time [11].

Standards for the disposal of oil and oily waste from oil and gas installations in the Mediterranean Sea are set out in a Protocol to the 1976 Convention for the protection of the Mediterranean Sea against Pollution (Barcelona Convention) [12]. The Protocol for the Protection of the Mediterranean Sea against Pollution Resulting from Exploration and Exploitation of the Continental Shelf and the Seabed and its Subsoil (Offshore Protocol) was adopted in 1994 [13], although it did not enter into force until 2011, and by 2017 only 14 out of 22 Mediterranean countries had signed the protocol (7 of which had also ratified it) [14]. Section III, Article 10 of the Protocol, which relates to oil and oily mixtures and drilling fluids and cuttings, sets out specific standards including a maximum oil content of 15 mg/l in undiluted discharges from machinery spaces and a maximum average oil content of 40 mg/l for production water and a maximum limit of 100 mg/l for any single discharge [14].

The European Union has also put in place offshore safety legislation, in order to reduce the risks of major accidents and their potential consequences for Mediterranean countries [15]. This legislation has to be implemented by EU Member States, and are therefore not applicable to non-EU countries bordering the south and east of the Mediterranean Sea. EU legislation includes:

- Commission Implementing Regulation No. 1112/2014 of 13 October 2014 determining a common format for sharing of information on major hazard indicators by the operators and owners of offshore oil and gas installations and a common format for the publication of the information on major hazard indicators by the Member States [16].

- Directive 2013/30/EU of the European Parliament and of the Council of 12 June 2013 on safety of offshore oil and gas operations and amending Directive 2004/35/EC [17]. Paragraph 51 of the Directive sets out that the European Union has acceded to both the Barcelona Convention [12] and the Offshore Protocol [13], while Article 1 of the Directive notes that it “establishes minimum requirements for preventing major accidents in offshore oil and gas operations and limiting the consequences of such accidents (Art. 1, Subject and scope).

- Commission Decision of 19 January 2012 on setting up the European Union Offshore Authorities Group [18], which has the task of serving as a forum for the exchange of experiences and expertise between national authorities and the European Commission (Art. 2, Task 1), and encompasses “*all issues relating to major accident prevention and response in offshore oil and gas operations within the Union, as well as beyond its borders, where appropriate*” (Art. 2, Task 2).

Shipping activities also pose a threat to the marine environment of the Mediterranean, and wider seas and oceans. One report from the early 2000s estimated that the total amount of crude oil passing through EU waters could be over 1 billion tons and that the Mediterranean Sea was most affected by dumping of hydrocarbons in the sea from ships, with nearly 490,000 tons being released annually [19]. A 2007 report indicated that there were more than 200 accidental spills from ships annually in the region, and that this reflects the high commercial activity taking place in the region [20]. The diversity of shipping in the region includes fishing fleets, ro-ro ferries, leisure craft, military vessels, large container carriers and tankers, and also fixed “vessels”, including offshore oil exploration and exploitation vessels [21].

In 2017 it was noted that there has been a decrease in major accidental oil spills from ships worldwide, with the average number of large oil spills from tankers (over 700 tonnes) having fallen to an average of 1.7 spills per year between 2010 and 2016 [22]. One major oil spill in the region, that of the MV Haven in April 1991 off Genoa, was identified in the 2017 report, which notes that between 1 January 1994 and 31 January 2013, approximately 32,000 tonnes of oil entered the Mediterranean Sea as a result of accidents, that figure including 13,000 tonnes originating from an incident at the Jiyeh power-plant in Lebanon in July 2006 (discussed below) [22].

The MV Haven, the biggest ever recorded in the Mediterranean, was one of only two of the largest oil spills occurring globally since the late 1960s, to take place in the waters of the Mediterranean Sea (see **Table 2** [23]). 144,000 tonnes of oil was spilled in the case of MV Haven (number 5 out of the top 20). The second incident was the Irenes Serenade spill in Navarino Bay, Greece in 1980, where 100,000 tonnes of oil was spilled (number 9). In both these cases more than 100,000 tonnes of oil were spilled [23].

Table 2. World Top 20 Major Oil Spills since 1967

| Rank | Ship Name | Year | Location | Spill Size (tonnes) |
|------|---------------------|------|--|---------------------|
| 1 | Atlantic Empress | 1979 | Off Tobago, West Indies | 287,000 |
| 2 | ABT Summer | 1991 | 700 nautical miles off Angola | 260,000 |
| 3 | Castillo De Bellver | 1983 | Off Saldanha Bay, South Africa | 252,000 |
| 4 | Amoco Cadiz | 1978 | Off Brittany, France | 223,000 |
| 5 | Haven | 1991 | Genoa, Italy | 144,000 |
| 6 | Odyssey | 1988 | 700 nautical miles off Nova Scotia, Canada | 132,000 |
| 7 | Torrey Canyon | 1967 | Scilly Isles, UK | 119,000 |
| 8 | Sea Star | 1972 | Gulf of Oman | 115,000 |
| 9 | Irenes Serenade | 1980 | Navarino Bay, Greece | 100,000 |
| 10 | Uriquiola | 1976 | La Coruna, Spain | 100,000 |
| 11 | Hawaiian Patriot | 1977 | 300 nautical miles off Honolulu | 95,000 |
| 12 | Independenta | 1979 | Bosphorus, Turkey | 94,000 |
| 13 | Jacob Maersk | 1975 | Oporto, Portugal | 88,000 |
| 14 | Braer | 1993 | Shetland Islands, UK | 85,000 |
| 15 | Aegean Sea | 1992 | La Coruna, Spain | 74,000 |
| 16 | Sea Empress | 1996 | Milford Haven, UK | 72,000 |
| 17 | Khark 5 | 1989 | 120 nautical miles off the Atlantic coast of Morocco | 70,000 |
| 18 | Nova | 1985 | Off Kharg Island, Gulf of Iran | 70,000 |
| 19 | Katina P | 1992 | Off Maputo, Mozambique | 67,000 |
| 20 | Prestige | 2002 | Off Galicia, Spain | 63,000 |

Note: Quantities rounded to the nearest thousand tonnes. Spills highlighted in grey occurred in the Mediterranean Sea

Source: ITOPF (2015) [23]

Other incidents occurring in the Mediterranean include a spill of 18,000 tonnes from the Cavo Cambanos in 1981 and a spill of around 12,200 tonnes of heavy fuel oil and slops from the collision of the Oil/Bulk/Ore Carrier Sea Spirit and the LPG Carrier Hesperus west of Gibraltar in 1990 [24]. While the latter incident took place outside the Mediterranean Sea, oil entered the region through the Strait of Gibraltar, carried by winds and currents, and presented a serious threat to the coasts and waters of Spain, Morocco and Algeria [25].

The most recent spill to occur in the Mediterranean Sea came from the shipwreck of the *Agia Zoni II* tanker, near the port of Piraeus and off the coast of Salamina, Greece on 10 September 2017. In that case the oil tanker, loaded with fuel oil and marine gas oil, sank [26]. The vast majority of oil on board was contained through the deployment of oil spill clean-up units [27] and the volume of oil spilled was estimated at about 700 tonnes [26]. The *Agia Zoni II* spill was just over one tenth of the size of the *Prestige* spill, number 20 in the top 20 spills set out in **Table 2**.

As well as oil and gas production and shipping, oil can also come from a range of activities including land-based sources such as petroleum refineries and power stations. In this latter example, as noted previously, a large release of oil came from an incident at the Jiyeh power-plant in Lebanon in July 2006 [22]. In that case, between 12,000 and 15,000 tonnes of fuel oil entered the marine environment following a missile attack on fuel tanks at the power-plant [28]. Due to delays in initiating clean-up operations, as a result of conflict in the region, more than 150 km of Lebanese coastline was contaminated by oil as the spill was carried out to sea and also dispersed along the coast of Lebanon [28]. It was subsequently found that some sandy beaches and rocky shorelines were extremely contaminated, while others were moderately or lightly contaminated [28]. As well as incidents such as the Jiyeh example, oil can also enter the marine environment from coastal oil refineries through effluent outputs. A 2007 report estimated that, between 1988 and 1997, some 22,563 tonnes of oil entered the Mediterranean Sea in this way each year [20]. The largest sources came from coastal refineries in: Algeria with 2,970.71 tonnes per year (tpy); Egypt (2,982.78 tpy); France (2,075.59 tpy); Greece (2,216.82 tpy); Italy (2,713.39 tpy); Spain (1,458.88 tpy); Syria (1,330.62 tpy); and Turkey (3,999.70 tpy) [20; Table 27]. The figures for France, Spain and Turkey do, however, include all their coastal waters, not just those located in the Mediterranean.

This book follows on from an earlier volumes on “Oil Pollution in the Baltic Sea” [29] and “Oil Pollution in the North Sea” [30]. Part I contains 15 chapters including the Introduction and Conclusions written by the volume editors. Part II contains a further 12 chapters including Introduction and Conclusions, again written by the volume editors. This Introduction to Part II provides a brief overview of the Mediterranean Sea and some of the problems of oil pollution facing it, including offshore exploration and exploitation activities, ship-source pollution, and oil pollution from land-based sources such as power-plants and petroleum refineries. It is followed by ten country-specific chapters presenting case studies for nine Mediterranean countries (in the case of Italy there are two chapters, one excluding and one specifically covering the Adriatic Sea).

In line with the earlier listing of Mediterranean countries, chapters are presented in a clockwise order, starting with Spain and moving round the region to Algeria. The chapter on oil pollution in Spanish waters considers the ecological and socio-economic importance of Spanish waters and shores as a means of illustrating the potential significant impact of an oil spill in that region. It then looks at major sources of oil pollution and the Spanish oil pollution prevention, prepared-

ness and response system, together with surveillance, forecasting and source identification activities undertaken by a range of Spanish institutions and agencies. The next chapter examines oil pollution in French waters, including an overview of the French Mediterranean marine pollution prevention and response organization, examines both operational and accidental oil spills, and highlights the main areas of progress made under the French jurisdiction as regards oil pollution. Two chapters relating to Italian waters are included in Part II. The first of these focusses on oil spill monitoring in Italian waters through the satellite mission COSMO-SkyMed, the largest Italian investment in space systems for Earth Observation, designed to provide data in a range of areas using Synthetic Aperture Radar (SAR) sensors for oil spill detection. The second Italian chapter focuses specifically on the Adriatic Sea, an area where oil pollution poses a threat from sources including offshore industry, natural seeps, oil and gas extraction, and ship-wrecks. While the entire Mediterranean Sea region has Special Area Status under MARPOL Annex I [31], which places limits on legal discharges of oily waste, for example, the Adriatic Sea holds Particularly Sensitive Sea Area (PSSA) Status, with even tighter restrictions than for the rest of the Mediterranean. The Italian chapter relating to the Adriatic Sea examines various sources of pollution including, for example, accidental and operational pollution from vessels in the region, offshore gas and oil activities and natural seeps. Also covering the Adriatic Sea are two further chapters. The first of these focuses on Slovenian waters in the northern-most part of the Adriatic Sea, an area of potentially high risk of significant damage to a short coastline full of important cultural sites, protected waters and coastal sites, and a particularly sensitive shallow sea. The second chapter is on the Croatian Adriatic area and discusses the large number of SAR images obtained in the region between 2003 and 2016 through a number of research projects, and identifies that there was a large number of oil slicks in the region, the main source of which were routine tank washing operations and illegal discharges. This poses a particular threat in the Adriatic, a small semi-enclosed sea in which accidents can have far reaching impacts on the coastal areas of all countries located within it. The chapter on oil pollution in the Turkish waters of the Mediterranean Sea, where there are significant vessel flows through the various Turkish Straits, examines the Turkish strategy for responding to accidental oil pollution through mechanical oil recovery techniques (chemical dispersants and not allowed without specific permission), The chapter also examines oil pollution monitoring, including both aerial and satellite monitoring, sources of pollution and penalties. The chapter on oil pollution in the marine waters of Israel has, as its main focus, the international legal framework and range of national legal measures in place to achieve Israel's commitment to prepare for, respond to, and combat all sources of pollution in the marine environment, particularly oil. It includes a discussion on oil pollution equipment in Israel. The chapter on oil pollution in the waters of Cyprus has, as its main focus, development of a National Contingency Plan (NCP) for Oil Pollution Combating, to which both the government of Cyprus and the private sector contribute. The NCP is considered to be extremely important as any new hydrocarbon discoveries in the region between Israel, Egypt and Cyprus has the potential to increase oil traffic and thus increase

oil spill risks in the region. The final national case study chapter examines oil pollution in the waters of Algeria which, as one of the top three oil producers in Africa, is potentially a major source of oil pollution on the southern shore of the Western Basin of the Mediterranean Sea. Algeria has six coastal terminals for the export of petroleum products along its 1,644 km coastline, together with five oil refineries (three of which are in coastal cities). The chapter considers the state of pollution in Algerian waters including its major sources. It also identifies that it is a member of the Barcelona Convention and REMPEC, has REMPEC approval for its National Contingency Plan to deal with such pollution, and is committed to reducing the quantities of petroleum hydrocarbons entering the marine environment. Part II then ends with some conclusions.

While it had been hoped to include chapters from every state bordering the Mediterranean Sea, geo-political problems in the region (particularly in the east, and along the North African coast) means that not all countries are included here. However, Part II does present a focused overview of the sources and risks of oil pollution in the Mediterranean Sea region in its various basins and is complemented by chapters on the International Context which appear in Part I of this volume. Part I includes chapters looking at the history, sources and volumes of oil pollution at the Mediterranean scale, shipping and oil transportation, the roles of the IMO, Barcelona Convention and REMPEC, and numerical modelling in both the Eastern and Western Mediterranean Sea, for example.

The book is aimed at a wide audience of national, regional and international agencies and government bodies, together with policy makers and practitioners in the fields of shipping, ports and terminals, oil extraction and environmental monitoring, for example. It is also aimed at graduate and undergraduate students in marine environmental sciences, as well as policy studies and legislative studies. The volume as a whole will provide a valuable resource of knowledge, information and references on oil pollution in the Mediterranean Sea.

Work started on this volume in November 2015 when a number of authors were approached to contribute to a volume on oil pollution in the Mediterranean Sea. The response to those invitations was overwhelmingly positive, with the large number of chapters making it necessary to produce the volume in two parts – Part I on the International Context and Part II on National Case Studies. Following final agreement with Springer-Verlag, in December 2015 to go ahead with this volume, it took just over two and a half years to bring together all the chapters.

As noted previously, since commencing with this volume there has been one major oil spill in the Mediterranean Sea, in the waters of Greece, from the sinking of the tanker *Agia Zoni II* near the port of Piraeus in September 2017. This can be seen as a very positive situation and illustrates the success of measures put in place to minimize oil pollution in the region over several decades. It also illustrates the need for countries in the region to continue to work towards oil pollution prevention and to cooperate in the event of an incident, in the event that an oil spill occurs.

This book follows on from the “Oil Pollution in the Baltic Sea” and the “Oil Pollution in the North Sea” volumes in the Springer-Verlag Handbook of Environmental Chemistry book series [29, 30], and following on from this Mediterranean

volume, plans are already in place for a volume on “Oil Pollution in the Black Sea”, again to be presented in two parts.

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