Ghost Marine Oil Spills

Who Pays and Who Suffers?

By

Amran Al-Kamzari, Tim Gray, Clare Fitzsimmons and J Grant Burgess

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Summary

This book investigates the problem of small-scale ghost oil spills at sea. Ghost spills (or unattributable or untraceable or mystery spills) are much more common than attributable spills, and small-scale spills are much more common than large-scale spills. Ghost spills cause a significant amount of ecological, environmental, economic, and social damage, and they are a violation of environmental justice because the perpetrators escape having to pay for clean-up and compensation. Instead of the polluter paying, the polluted coastal communities, which are often impoverished, end up bearing these costs, which is clearly unfair. The Musandam Peninsula serves as a case study because of its strategic location in the Strait of Hormuz, a major oil transport route in the Arabian Gulf. Residents report that oil slicks and tar balls on Musandam's coast result from tanker and ship discharges in the Strait of Hormuz. There are compensation schemes available to meet the costs of marine oil spills, but they generally require proof that a spill has been caused by a vessel, and such proof is very hard to obtain in the case of ghost spills. The stakeholders interviewed in this study proposed two solutions: using advanced technology to detect spillers more effectively; and establishing a regional compensation fund for ghost oil spills paid for by ship owners. Additionally, stakeholders emphasised the need for greater community involvement in decision-making about dealing with ghost oil spills.

Dedication

by Amran Al-Kamzari

This book originated in a PhD thesis submitted in 2024 by the lead author, Amran Al-Kamzari, to the School of Natural and Environmental Sciences at Newcastle University in the UK under the supervision of the three co-authors. The following Dedication has been composed by Amran.

This book is dedicated to my dearest parents, though they did not hold formal degrees, they remain the most profound professors of my life. Their lessons in love, integrity, and hard work have shaped my path and continue to guide me. Thank you for being my greatest and most foundational teachers. I also dedicate this work to my beloved wife, and to my cherished children, along with my dear brothers and sisters. The immense beauty and joy you all bring into my life is beyond measure. Your love, support, and unwavering presence have been my greatest blessings. This book is for you. Lastly, I dedicate this work to the land of the Sultanate of Oman and its promising future. I am filled with hope and optimism for the continued progress and prosperity of this great nation.

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Amran Al-Kamzari

Glossary

Ashura: A government consultation committee

Ballast Water: Water stored in a ship's hull to provide stability and improve maneuverability during a voyage.

Bunker Oil: Heavy fuel oil used in shipping which is typically derived from crude oil.

Bunkering: The process of supplying vessels with fuel, such as oil or liquefied natural gas (LNG), while they are docked in a port or at sea

Dhow: A traditional wooden sailing vessel used for centuries in the Arabian Peninsula.

Double Hull: A vessel where the bottom and sides of the ship have two complete layers of watertight hull surface: one outer layer forming the normal hull of the ship, and a second inner hull which is a few feet inboard and forms a redundant barrier to seawater in case the outer hull is damaged and leaks.

Ghost Spills: Ghost (or unattributable or untraceable or mystery) marine oil spills where the responsible party or source is unknown and therefore cannot be held accountable for the consequent environmental damage.

Majlis: A traditional gathering or reception room within a house or communal space.

Oil Spill: The release of liquid petroleum hydrocarbon into the environment, typically as a result of human activity.

Sheikh: Tribal Head.

Sunnan Al-Bahar (Sea Code) committees: A platform for fishermen to come together and address any challenges they encounter in their fishing work.

Wali(s): Ruler’s representatives in regions.

Willayat(s): Regions within governorates.

Acronyms

ACLN: Adversarial Corrector Learning Network

AIS: Automatic identification system

AUV: Autonomous underwater vehicle

BC: Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean Sea against Pollution

bbl: Barrels

BP: British Petroleum

BPP: Beneficiary Pays Principle

CCL: Climate Change Levy, UK

CLC Convention: International Convention on Civil Liability for Oil Pollution Damage

COPE Fund: Compensation for Oil Pollution in European Waters Fund

CVOPCF: China Vessel-Source Oil Pollution Compensation Fund

EA: Environment Authority, Oman

EEZ: Exclusive Economic Zone

EIA: Environmental Impact Assessment

EJ: Environmental justice

EMSA: The European Maritime Safety Agency

ESI: Environmental Ship Index

EU: European Union

FAO: Food and Agriculture Organization

FGD: Focus group discussion

FOPCF: Finnish Oil Pollution Compensation Fund

GB: Governor of Buraimi

GCC: Gulf Cooperation Council

GM: Governor of Musandam

GT: Gross tonnes for ships

ICOPPRC: International Convention on Oil Pollution Preparedness, Response, and Cooperation

IMO: International Maritime Organization

INTERPOL: International Criminal Police Organization

IOPC Fund: International Oil Pollution Compensation Fund

ITOPF: International Tanker Owners Pollution Federation Ltd

KI: Key informant

MARPOL: International Convention for the Prevention of Pollution from Ships

MEMAC: Marine Emergency Mutual Aid Centre

MENELAS: Mediterranean Network of Law Enforcement Officials relating to MARPOL within the framework of the Barcelona Convention

MEPC: Marine Environment Protection Committee

MERCU: Marine Emergency Response Coordination Unit

MHT: Ministry of Heritage and Tourism, Oman

MNZ: Maritime New Zealand

MOAFWR: Ministry of Agriculture and Fisheries Wealth and Water Resources, Oman

MSC: Maritime Security Centre, Oman

MTCIT: Ministry of Transport, Communications, and Information Technology, Oman

NOAA: National Oceanic and Atmospheric Administration, USA

NZOPF: New Zealand Oil Pollution Fund

OILPOL: Oil Pollution Convention of 1954

ONOSCP: Oman National Oil Spill Contingency Plan

OPA: Oil Pollution Act, Oman

OSLTF: Oil Spill Liability Trust Fund, USA

OSPAR: Convention for the Protection of the Marine Environment of the North Atlantic

OSRL: Oil Spill Response Limited

OSRO: Oil Spill Response Organization

OWWC: Oman Water and Wastewater Company

PDO: Petroleum Development of Oman

PESCO: Omani Company for Petroleum and Environmental Services

POMC: Pollution Operation Monitoring Centre, Oman

PPM: Parts per million

PPP: Polluter Pays Principle

P&I: Protection and Indemnity

RAF: Royal Air Force, Oman

RECOFI: Regional Commission for Fisheries Management in the Gulf

REMPEC: Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea

RNO: Royal Navy of Oman

ROP: Royal Oman Police

ROPME: Regional Organization for the Protection of the Marine Environment

SDR: Special Drawing Rights

SAR: Synthetic Aperture Radar

SOPF: Ship-source Oil Pollution Fund

SQU: Sultan Qaboos University

TEU: Twenty-foot Equivalent Unit

TOVALOP: Tanker Owners' Voluntary Agreement Concerning Liability for Oil Pollution

UAE: United Arab Emirates

UAV: Unmanned aerial vehicles

UN: United Nations

UNCLOS: United Nations Convention on the Law of the Sea

UNEP: United Nations Environment Programme

US$: United States dollars

VTCS: Vessel Traffic Control System

WHO: World Health Organization

5Ocean: Five Ocean Environmental Services

Chapter 1
Introduction and Literature Review

Introduction

Oil pollution is a serious threat to the marine environment. The toxicity of petroleum hydrocarbons damages marine flora and fauna natural habitats and has direct impacts on fisheries, seawater desalination installations and coastal amenities such as tourist attractions, beaches, and harbours. Oil pollution therefore threatens livelihoods, homes, businesses, and communities' economic, social, and environmental well-being (Ahmad et al., 2021), causing significant problems for coastal states across the world (Aldosari, 2019; Weitz, 2018). Annually, it is estimated that between 0.7 and 4.15 million tonnes of marine oil pollution is released globally from anthropogenic sources (Ishak et al., 2020; Abdulla and Linden, 2008). The causes of oil spills are many and varied but are usually associated with the transportation of oil by tankers, offshore oil exploration and extraction operations (Khan, 2008). In 2020, over 2 billion tonnes of crude oil were transported by sea (VSM, 2022).

Cargo and container ships are powered by oil-based fuels and lubricants (ITOPF, 2022) which leak from machinery and drain into bilge tanks at the bottom of the vessels where they are stored until being discharged. Between each trip, tankers are obliged to clean out this sludgy waste (IMO, 2019; Walker, 2016) and many do so illegally at sea (Dietl, 2013; Ahmad et al., 2021). These routine discharges are calculated to total between 60 and 175 million gallons per annum (Anyanova, 2012). In European waters alone, there are approximately 3,000 such dumping events every year (Paddison et al., 2022). They occur because vessel owners want to save the time (Gullo, 2011) and cost (Udechukwu & Jonah, 2020; Kontovas et al., 2010) of legal disposal in ports. Escaping port disposal charges can save between US$ 80,000 and US$ 220,000 per annum (Vollaard, 2017) which could be 5-12% of a ship's running costs (Crist, 2003) (see Table 1.1).

Table 1.1 Estimated costs (Euros) for legal disposal of two types of oily waste streams from vessels in UK ports. (source: Crist, 2003)

Vessel type	Discharging of heavy fuel oil sludge into port waste reception facilities		Discharging of oily bilge water into port waste reception facilities	
	Discharge cost following a 30-day voyage (Euros)	Notional daily cost (Euros)	Discharge cost following a 30-day voyage (Euros)	Notional daily cost (Euros)
Tanker	1,800	60	1,051	35
Bulker	1,375	46	843	28
Container	3,780	126	711	24
Dry Cargo	2,991	99	165	6

At sea discharges were virtually outlawed by the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78; Guerrini et al., 2021; Kostianoy & Carpenter, 2019) by forbidding discharges except when all the following conditions are satisfied:

1. The ship is proceeding en route.
2. The oily mixture is processed through an oil filtering equipment;
3. The oil content of the effluent without dilution does not exceed 15 parts per million (ppm);
4. The oily mixture does not originate from cargo pump-room bilges on oil tankers; and
5. The oily mixture, in case of oil tankers, is not mixed with oil cargo residues.

Several illegalities associated with these violations include obstruction of investigations by falsifying records, interfering with monitoring systems and release of bilge as well as sludge (Freestone, 2013).

Large-scale accidental marine oil spills attract huge media attention, but small-scale deliberate operational discharges from the oil industry, especially from tankers, often go unnoticed, despite the fact they are the single largest anthropogenic source of marine oil pollution, according to the National Academy of Science (Kostianoy & Carpenter, 2019). Even the slightest oil spill into the ocean causes a thin film to form on the water's surface which can quickly spread widely (Zhao et al., 2014) and cause a significant impact on the marine environment.

As illustrated in Figure 1.1, the number of oil spills over 7 tonnes have reduced by more than 90% since 1970 (ITOPF, 2022). However, the reporting of small spills (less than 7 tonnes) is unreliable and data are often incomplete (Su et al., 2019; ITOPF, 2022), so it is unclear whether the number of small spills is decreasing or increasing. Nevertheless, it has been estimated that over 80% of spills recorded worldwide since 1970 were small (ITOPF, 2019) and that between 1974 and 2015 there was an average per year of 1,815 illegal waste oil discharges of <7 tonnes (Su et al., 2019).

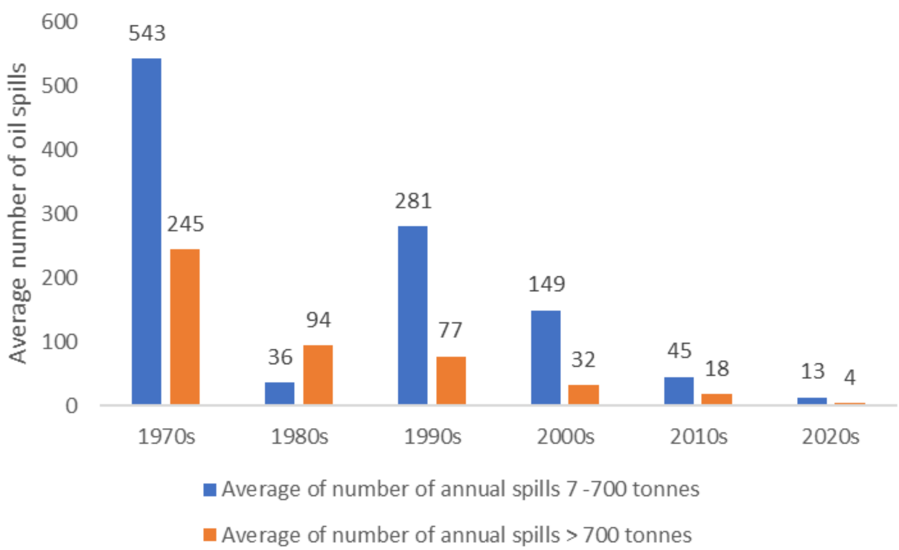

Figure 1.1: The average number of oil spills (7 -700 tonnes) and (>7 tonnes) from tankers (Source: ITOPF, 2022)

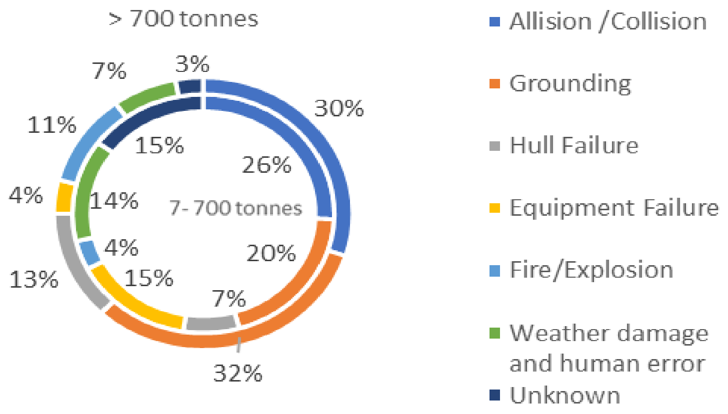

Figure 1.2: Causes of tanker spills between 7-700 tonnes and more than 700 tonnes, 1970-2022
(Source: ITOPF, 2022)

Figure 1.2 shows that the most frequent causes of oil spills > 7 tonnes from tankers are allisions / collisions and groundings. It presents statistics on the percentage of causes of oil spills for those between 7 to 700 tonnes and those greater than 700 tonnes. Oil spills by unknown sources are more common for spills between 7 and 700 tonnes than for spills > 700 tonnes, but most common for spills < 7 tonnes (NOAA), 2019).

The mechanisms for impacted countries to claim compensation for damage caused by marine oil pollution from tankers are limited to spills that can be attributed to a specific vessel. This book focuses on oil spills that cannot be attributed to a specific tanker, synthesizing the data on the extent, causes and costs of marine oil pollution from these 'ghost' vessels, an under-researched area. This problem is illustrated with data from the Hormuz Strait in the Arabian Gulf, the busiest oil tanker shipping lane in the world, and from the impacts of oil spills on the adjacent Musandam Peninsula in Oman.

The remainder of the chapter is as follows. The next section discusses ghost oil spills and actions taken to identify their sources. The following section describes the current mechanisms for compensation and their effectiveness in tackling the issue of obtaining redress for ghost oil spills.

Next, the problem is exemplified in a case study of oil spills off the Musandam Peninsula. The marine environment and human communities of the Musandam Peninsula are particularly vulnerable to oil pollution from passing tankers. The final section summarises the findings of the chapter.

Ghost oil spills

Ghost spills pose an intractable problem for regulatory bodies (Beegle-Krause, 2018). Currently, no international agreement exists which explicitly addresses the issue of liability of damages resulting from them (Choudri et al., 2015). Since the International Oil Pollution Convention (IOPC) fund requires the identity of the polluting ship-owner to be known (Butt, 2013; IOPC Fund, 2020), if the complainant fails to prove that the damage occurred due to a specific tanker accident or discharge, the fund will not provide compensation. This creates a serious challenge for countries because it is often extremely difficult to prove an oil spill came from a particular source. For example, oil spills can be quickly transformed by evaporation or dispersal (Lemkau et al., 2010) which will drastically alter their footprints and make them much harder to link to particular vessels (Karakoç et al., 2015; Lindgren et al., 2016).

Some forensic techniques are being developed in Turkey that might improve the rate of identification of ghost oil spillers in the future. The Turkish government is using chemical footprint technology to compare the footprints of ghost oil spills with the footprints of all recognized candidate source oils to track the source (Karakoç et al., 2015), and this technology has been effective in some cases (Rodrigue, 2020).

Five national governments have established funds that pay compensation for pollution from ghost vessels: Finland (The Finnish Oil Pollution Compensation Fund) (Finnish Ministry of Environment, 2020); China (The China Vessel-Source Oil Pollution Compensation Fund) (Li et al., 2013; Dong et al., 2015; Zhu et al., 2013); New Zealand (The New Zealand Oil Pollution Fund) (Maritime New Zealand, 2022); Canada (The Ship-source Oil Pollution Fund) (ClearSea, 2019); and the USA (The Oil Pollution Act) (Mudrić, 2009; National Pollution Funds Center, 2009). However, although there is a lack of published research on the occurrence and compensation of ghost spills and there are no records kept for oil spills below 7 tonnes, the number of incidents where national governments have compensated for oil spills from unattributable sources is likely to be considerably fewer than the number of uncompensated ghost oil spills.

Clean up costs for oil spills

Clean-up costs depend on a range of complex factors, including the nature of the spilled oil product, the location, the time of the spillage, liability limitations, regulations in place, and clean-up techniques (Carpenter, 2016). Oil type (Fili & Songip, 2017), location (Etkin, 2004), and the total amount spilled (Kontovas et al., 2010) are regarded as the most important factors considered when establishing a per-unit account of the clean-up response. Doerffer (2013) added coastal population density, while Kontovas et al. (2010) added transportation expenses (which can amount to $4 to $6 per tonne); disposal at a landfill site (which can range from $3 in a dumpsite to $100 per ton in a controlled site with impermeable membranes and leachate monitoring stations); and incineration (which costs between $3 and $250 per tonne in a fully-enclosed plant with smoke emission control and other safety features). White (2002) added administrative support costs in making decisions on preferred response techniques, the mobilization of equipment and personnel, and the cost of hiring experts to analyse damage caused by the oil spill (see Table 1.2).

Table 1.2: Marine oil spill cleanup cost by spill size for US spills (Source: Jonah and Agunwamba, 2020)

Oil type	Clean-Up Cost of US Spilt (US$ / Tonne)	Clean-Up Cost of US Spilt (US$ / litre)
No. 2 diesel fuel	$3,607.38/tonne	$3.24/liter
Light crude	$3,131.08/tonne	$2.86/liter
No. 5 fuel	$8,693.58/tonne	$7.81/liter
Crude	$14,520.66/tonne	$13.05/liter
Heavy crude	$21,091.56/tonne	$18.95/liter

There are mechanisms in place to compensate impacted countries for these clean-up costs. For example, under the MARPOL Convention, there are several procedures for providing compensation to victims of damage caused by oil spills from identified vessels. The most prominent is the International Oil Pollution Compensation (IOPC) fund scheme. Concern about oil spills and a series of problems over liability and compensation claims played a role in the establishment of the IOPC fund scheme in 1992, facilitated by the International Maritime Organization (IMO), as a regime to reimburse victims of oil pollution (Schmitt & Spaeter, 2005; IOPC Fund, 2020). The IOPC fund is an autonomous legal entity - an intergovernmental organization outside the United Nations – of which only states can be members. Two international conventions are the basis of the IOPC fund: the Convention on Civil Liability for Oil Pollution Damage (CLC) and the Convention on the Establishment of an International Fund for Oil Pollution Damage (Li et al., 2013; Rath, 2015). These two conventions are associated with Annex I of the MARPOL Convention 1973/1978, which forbids oil contamination at sea. The IOPC fund is financed by levies taken from the oil beneficiaries in Member States who receive over 150,000 tonnes of crude oil or heavy fuel oil at their ports or terminal facilities during the calendar year after being transported by sea (Kiran, 2010). These levies are calculated from data contained in reports of oil receipts from contributors that are submitted to the IOPC Secretariat by the governments of Member States (Zhao et al., 2014). So the funds for the International Convention on Civil Liability for Oil Pollution Damage (CLC) and the International Oil Pollution Compensation Funds (IOPC) are provided by the oil industry (Handl & Svendsen, 2019). These conventions ensure that victims of oil pollution caused by spills involving oil-carrying ships can receive adequate compensation (Juste-Ruíz, 2010).

The IOPC fund is managed by its Member States' governments, and the governing bodies meet twice a year to agree on compensation policies, legislation and finances (Kiran, 2010; IOPC Fund, 2020). The aim of the IOPC fund is to compensate parties who have fallen victim to oil pollution damage resulting from oil tankers in situations where the CLC has no liability. This can be because a CLC exemption applies to the ship-owner, or the ship-owner is unable to satisfy their CLC duties and their insurance is inadequate, or the loss exceeds the assets of the ship-owner (Billah, 2011). However, according to its Claims Manual, the IOPC fund will not pay compensation if the complainant is unable to prove that the damage suffered was the result of spillages involving one or more ships, as stipulated in the Conventions (Su et al., 2019). The IOPC fund provides additional funding – from the Supplementary Fund – if the payable amount is insufficient to cover the damage (Soto-Oñate & Caballero, 2017). The entire sum of compensation accessible in the IOPC fund is US$ 1,047 million; US$ 283.6 million in the Supplementary Fund; US$ 125.4 million in the 1992 fund; and US$ 6.3 million in the CLC (IOPC Fund, 2020).

Such global institutions are successful at obtaining compensation for large attributable spills, but not so successful at obtaining compensation for small ghost spills (IMO, 2021; IOPC Fund, 2021; UNEP, 2014). For example, the IOPC works quite well where specific (known) ships are damaged and oil leaks result (Yang, 2017). It works less well for ghost oil spills since whilst in principle the IOPCF may pay for compensation for spills from unidentified ships, there must be proof that the spill came from a ship transporting oil as cargo (Rath, 2015). There are two cases of ghost spills where the IOPCF paid compensation - the "Incident in the United Kingdom" in 2002 (IOPC Fund, 2003) and the "Incident in Bahrain" in 2003 (IOPC Fund, 2004). In these cases, the claimants were able to prove the spills were caused by tankers, which is very hard.

Impacts of oil spills in the Arabian Gulf

To illustrate the impacts of oil pollution from ghost vessels, in this section we present data on the Arabian Gulf, where oil spills are a serious problem (Farahat, 2016). The Arabian Gulf is a semi-closed sea located in a subtropical area that is dominated by offshore exploitation and transport of oil and gas products (Fatima & Jamshed, 2015). Close to two million containers of oil are leaked annually into the Gulf's marine environment because of the activities associated with oil traffic in the Gulf waters (Alqattan & Gray, 2021; Al-Saad & Salman, 2012). Although there are other dangers to the Gulf's marine ecosystem (Buskey et al., 2016; Carpenter & Nations, 1997), including overfishing, eutrophication, siltation, non-oil pollution, and global climate events (Mitra & Zaman, 2016), marine oil spills are the chief causes of marine pollution in the region (Chitrakar, et al., 2019).

Table 1.3: Comparison of volume of crude oil and petroleum products transported (million b/d) through the world's straits (Source: U.S. Energy Information Administration (EIA), 2017, 2019, 2023. Note: figures for 2017 are not available)

Location	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Strait of Hormuz	17	16.8	16.6	16.9	17	18.5	21.4	20	18.4	19	21.1	20.9
Strait of Malacca	14.5	15.1	15.4	15.5	15.5	16	23	23.1	22.8	21.9	23.7	23.7
Suez Canal and SUMED Pipeline	3.8	4.5	4.6	5.2	5.4	5.5	6.4	6.2	5.3	5.1	7.3	8.8
Bab el-Mandab	3.3	3.6	3.8	4.3	4.7	4.8	6.4	6	5.2	5.4	7.5	8.6
Danish Straits	3	3.3	3.1	3	3.2	3.2	3.3	3.4	3.1	4.2	4.9	4.9
Turkish Straits	2.9	2.7	2.6	2.6	2.4	2.4	3.4	3.5	3.3	3.4	3.2	3.4
Panama Canal	0.8	0.8	0.8	0.9	1	0.9	1.4	1.5	1.7	1.8	2.1	2.1

The Strait of Hormuz lies between Iran and Oman in the Arabian Gulf (see Figure 1.4). It is part of the world's busiest maritime region, with sea traffic growing steadily (Modarress et al., 2012; Al-Maamary et al., 2017). More goods, services, resources and technology are shipped through it than through any other strait in the world (U.S. Energy Information Administration 2017, 2019, 2023) (see Table 1.3). The Hormuz and Malacca Straits rank as the world's most critical oil transit passages. Between 41,000 and 53,000 ships transit the Hormuz trait every year, approximately one-third of which are oil tankers which made 220,000 regional port and terminal calls in 2019 (see Figure 1.3). Figure 1.3 shows that over time, the number of port calls has increased, while the number of vessels passing through the Strait of Hormuz has only slightly increased due to the larger size of tankers and ships since 2010. In the past, ships had a container capacity of around 4,000 TEU (twenty-foot equivalent unit), but now they have a capacity of over 24,000 TEU (Chen et al., 2019a) so each tanker can make more port calls in the region to collect crude oil. Hormuz Strait is a narrow, busy and strategically important transit route for much shipping (Searle, 2019; Jafari, 2012) and it is the only route through which oil is exported from the Gulf States (Dietl, 2013).

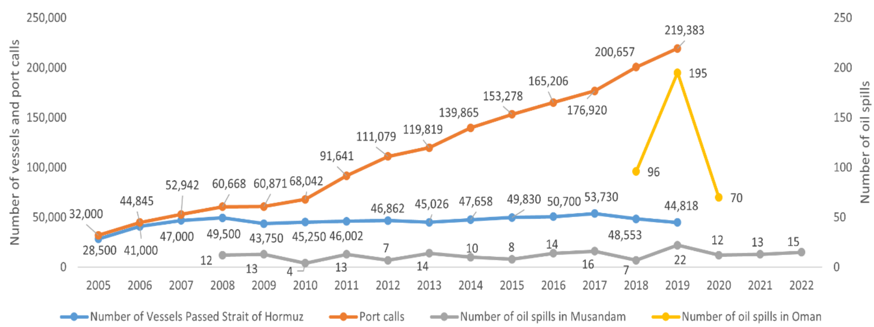

Figure 1.3: Number of vessels in the Strait of Hormuz 2005-2019 and number of oil spills in Oman 2018-2020 and Musandam 2008-2022 (Source: Al-Janahi, 2020; Muscat Daily, 2022; Environment Authority, 2020)

Table 1.4 shows the annual volume of crude oil and petroleum products transported through the Strait of Hormuz during 2018-2022. In 2022, the average oil flow through the strait reached 21 million barrels per day, accounting for approximately 21% of the world's total consumption of petroleum liquids.

Table 1.4: Annual Volume of crude oil, condensate, and petroleum products transported through the Strait of Hormuz (2018-2022) million barrels per day (Source: U.S. Energy Information Administration, 2023, 2019, 2017)

The volume of crude oil	2018	2019	2020	2021	2022
Total oil flows through the Strait of Hormuz	21.3	19.9	18.3	18.8	20.8
World maritime oil trade	77.4	77.1	71.9	73.2	75.2
World total petroleum and other liquid consumption	100.1	100.9	91.6	97.1	99.6

Previous studies of the impact of oil pollution in the Arabian Gulf indicate that spills here are mainly caused by the illegal discharge of ballast water (O'Neil & Talmadge, 2008). Tankers often clean out their tanks in Oman waters before entering the Gulf to load oil cargo, and this involves discharging contaminated ballast water, dirty bilge, sludge and slop tank oil causing serious pollution of the coastline.

Oil spills in the Musandam Peninsula

The Musandam Peninsula is located within the northern territory of Oman and juts out into the Strait of Hormuz, at the eastern end of the Arabian Gulf (see Figure 1.4). It is a region geographically isolated from the rest of Oman, separated by the northeast region of the United Arab Emirates (Al Abri, 2018). This physical separation from the main part of Oman and the capital Muscat where Oman governmental institutions are based, makes the Peninsula administratively and politically detached (Berg et al., 2014). Given the high density of shipping traffic in the Strait of Hormuz, the Musandam Peninsula is particularly vulnerable to oil spills from passing tankers, but because of its isolation from the rest of Oman, action by Government to tackle the issues they raise in the Musandam Peninsula is often slower and given less priority than in the rest of the country (Berg et al., 2014). The impacts of ghost oil spills on the Musandam Peninsula have not been comprehensively studied, but a review of the limited academic and grey literature available indicates wide-ranging environmental, societal and economic impacts. For example, in 2017, almost half the mangroves (the Avicennia marina) in the coastal area of Oman were damaged by a major oil spill, and one-third died (Issa & Vempatti, 2018). Issa & Vempatti (2018) noted that 30,000 birds died due to oil spills along the Gulf Cooperation Council (GCC) coastline, including the Musandam Peninsula. Yaghmour et al., (2022) showed that 84.6% of sea snakes in the Gulf of Oman, including the Musandam Peninsula, were observed in 2021 with oil covering 75–100% of their bodies.

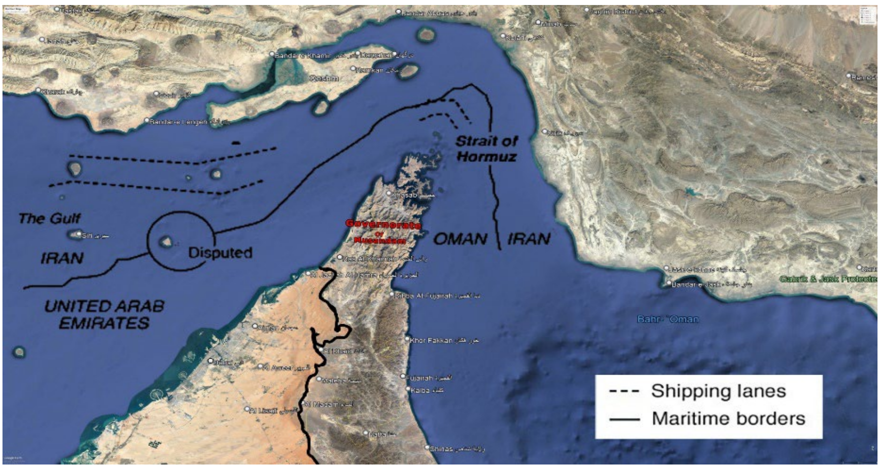

Figure 1.4: Passage of ships and tankers via Strait of Hormuz (Source: adapted by the lead author from Google map)

Environmental and socio-economic impacts of oil spills on the Musandam Peninsula

The socio-economic impact of oil spills on Musandam is also striking. The prime source of protein for Musandam people is fish (Berg et al., 2014). Fishing in the Musandam region is based solely on the traditional artisanal fishery which in 2018 had 2,126 fibreglass fishing boats and 93 dhows in fishing villages in Daba, Khasab and Bukha, with 3,549 fishermen (Ministry of Agriculture, Fisheries and Water Resource, 2022). Oil pollution impacts fish because they ingest oil through their gills (Krupp & Abuzinada, 2008) and this affects their growth, metabolic rates, and reproductive success by damaging their eggs and larvae (Grosell & Pasparakis, 2021; Langangen et al., 2017; Karam et al., 2019). Fishing gear is damaged by oil clogging up engines and making nets unusable (Issa & Vempatti, 2018). The health of people eating oil-contaminated fish can be adversely affected (Laffon et al., 2016).

People in the Musandam Peninsula get much of their drinking water from the sea via desalination plants. Oil pollution spills adversely affect the equipment and function of desalination plants and subsequently the quality and taste of drinking water (Berg et al., 2014). Washed-up marine oil pollution also destroys the landscape of the beaches, which makes them unsuitable for recreational uses. On the Musandam Peninsula, it is regarded as a normal part of summer and beach life (UNEP, 1982) for children from local villages who play on the sandy beaches to come home with tar on their feet and hands. Oil spills in Musandam have also caused losses in tourism sectors such as hotel accommodation, transportation, guides, and recreational fishing and diving (Badri & Sedaghat, 2017). Figure 1.5 is a graphical illustration of the oil spill impact system on the marine ecosystem and human life in the Musandam Peninsula.

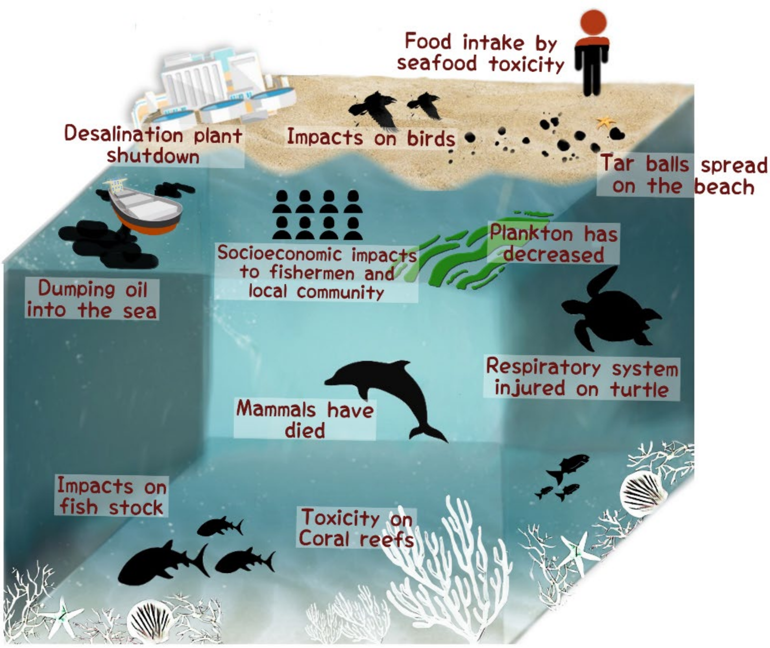

Figure 1.5: Oil spill impacts diagram on marine ecosystem and human life in Strait of Hurmuz Peninsula (Source: created by the lead author using PICSART application)

The Musandam Peninsula has been designated by the International Convention for the Prevention of Pollution from Ships as a ‘Special Area’ (Fartoosi, 2013). Therefore, all discharges of oil/waste are prohibited except in very specific circumstances (Mason, 2003; IMO, 2020). Nevertheless, the Peninsula continues to experience many oil spills. Thousands of oil tankers pass close to it every year, many of them illegally discharging oil or diluted mixtures containing oil into the marine environment adjacent to the Musandam Peninsula (Environment Authority, 2020). Figure 1.3 shows that the number of oil spills on the coast of Musandam has persisted or is rising as the density of shipping has grown in the Strait of Hormuz (Kalehsar & Kalehsar, 2021).

In Musandam, it is difficult to identify the vessels responsible for the oil spills because the slicks and tar balls which reach the Musandam coast discharged by tankers when passing through the Strait of Hormuz change their chemical features, which means their molecular footprints cannot be identified (Lemkau et al., 2010). Muscat Daily (2022) reported that in 2021, the Chairman of the Environment Authority announced it had received 361 complaints related to pollution in the last three years, with most filed in 2019. Approximately 140 oil spills were identified by the Environment Authority as caused by unknown vessels between 2008 and 2019 in the Musandam Peninsula – i.e., on average more than one ghost spill per month. However, anecdotal evidence suggests there are many more ghost oil spills on the Musandam coast than are officially recorded since fishermen and local people do not report them all to the authorities. This is because oil spills are so frequent that people accept them as ‘normal’; most of them are small; and there is a lack of awareness about reporting procedures.

Some measures have, however, been taken to deal with oil spills in Musandam. For example, the Governorate of Musandam's Department of Environment and Climate Affairs launched a campaign to tackle the effects of oil pollution from ghost vessels through the Strait of Hormuz. According to Arab Today (2017), Alshehi (2019) and Ashok (2021), environmental experts have collaborated with the Musandam Navy and the Khasab Municipality by offering vessels to transport clean-up equipment to the working area. Residents of the Dorsany Khawr area took a central role in the process of cleaning their beach, with a slew of divers working alongside Nature Conservancy employees to remove oil pollution, consisting of suspended oily masses on the seafloor. Kothaneth (2017) reported that the Government of Oman, represented by the Environment Agency, in coordination with the Oman Navy, was conducting marine investigations to find out the cases of oil pollution on the beaches of the Musandam Governorate. Illegal behaviour and violations of oil tankers' and sea ships' regulations were observed, including discharge of oily waste on the coasts of Musandam, especially in the eastern area of the Strait of Hormuz, such as Daba city and its villages, but they did not find the guilty vessels. However, the Oman government has done little to obtain or provide compensation for residents affected by the spills.

Conclusion

This chapter has revealed several important gaps in the literature on the problem of unattributed oil spills. While previous studies describe incidences of major oil spills across the world; their causes, their effects, attempts to prevent them from occurring; and organizations established to provide compensation for the damage they inflict on vulnerable coastlines, there is little coverage of how compensation can be obtained for damage caused by marine oil spills from unidentified or ghost vessels. There is also negligible discussion in the literature on the failure of international agreements to address the problem of liability for damages caused by unattributable oil spills, despite five states having established their own arrangements for dealing with ghost spills.

The fact is small-scale ghost marine spills pose a very difficult problem for regulatory bodies (Beegle-Krause, 2018). The nub of the problem is that ghost spillers avoid having to pay for clean-up costs and livelihood losses. As a result, either national or international bodies or victims of oil spills have to bear these costs. Since few national or international bodies are willing to pay compensation for ghost spills, the burden generally falls upon victims. This is grossly unfair because it violates the polluter pays principle and is an environmental injustice. As we have seen in the case of Musandam, marginal groups are particularly at risk of such injustice.

Further research is needed to explore possible ways of identifying ghost oil spillers and finding equitable ways of paying for clean-up of unattributed marine oil pollution. Neither regional organizations nor the international community seem greatly exercised about this injustice, and so a collective political solution appears unlikely. It may be that a technical solution is more promising – i.e., a way of identifying ghost spillers. Some forensic techniques are being developed in Turkey that might improve the rate of identification of mystery oil spillers (Karakoç et al., 2015), and this technology has already proved effective in some cases (Rodrigue, 2020). The application of generative artificial intelligence (AI) to this technology might prove to be a game changer in removing the scourge of small-scale ghost marine oil spills in Musandam and other coastal waters.

The next chapter provides the theoretical foundation of environmental justice which informs the search for an equitable solution to the problem of mystery spills and describes the research methods used to investigate the problem and suggest potential solutions.