The Impacts Of Oil Drilling On Maritime Areas: The Prominent Cases In World Seas

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Abstract: in the recent years, fast growing world population and reduction of scarce resources have forced people to look for new sources. In this manner, decreasing of terrestrial based sources has shifted the attentions of nations to the marine related resources in terms of having reserves of oil and gas that located undersea areas of the world. However, exploration, drilling and transferring oil in maritime areas may have significantly harmful effects on marine wildlife, coral reefs, environment etc. Especially oil spilling may threat human health and life, may damage marine ecosystem, may destroy different marine species, may reduce biological diversity, may jeopardize bird populations, may disrupt food chain and, may cause interruption of national and international transportation. Due to these vital reasons, this study has explored the effects of oil drilling applications on maritime areas with common cases of world seas. In order to emphasize the impacts of oil drilling on maritime areas, a detailed literature study has been conducted within the scope of this study. Subsequently, the prominent examples of oil drilling activities in world seas have been investigated. In the end, the paper has concluded with prudential suggestions by taking advantages of current implementations for oil drilling in prominent maritime areas.

Index Terms: oil drilling, maritime areas, world seas, prominent cases.

1. INTRODUCTION

THE exploration activities of oil and petroleum are affected by strategic and geopolitical reasons. Increasing needs and decreasing fossil fuel reserves are actually taking attentions of nations to new sources by diversifying them. The world energy demand is expected to increase by 60% in 2002 and 2030. In 2030, oil demand is estimated to become 121 million barrels per day (www.un.org). Due to the need for increased resources, the industrialization of the deep sea is becoming widespread all around the world. Increasing oil drilling activities in deep sea ecosystem with each passing day cause troubles in environmental management (Cordes et al., 2016). It is a well known fact that marine environment is deeply affected by many human activities and must be attentively managed to prevent irrecoverable hazards on marine ecosystems (Gordon et.al, 2014). Chemical oil distributors' work by transferring the oil from the sea surface to the water column in small droplets where they can disperse, and then deteriorates more rapidly by naturally occurring microorganisms. Former studies were conducted related with oil spill, following the Torrey Canyon. (Gordon et.al, 2014). Such events have attracted scholars to understand the environmental impacts related with drilling activities on maritime areas. Detailed researches have been conducted on this issue and the results of them are very impressive. The profoundly information associated with the impacts of oil drilling activities on maritime areas have been discussed in literature review section of this paper. Then the prominent cases of oil drilling activities in world seas have been examined within the scope of the study. Lastly, the research was concluded with future proposals related with the effects of drilling activities on maritime areas.

2 LITERATURE REVIEW

Maritime areas and marine biodiversity are being shared and attracted by stakeholders and some interest groups such as offshore developers, recreational users and commercial fishers. The involvement of these multi-marine users in conservation plans is crucial to realize achievable plans for the world. Furthermore, competition for offshore activities such as sand mining, commercial fishing and offshore power plants is becoming increasing from necessity of economic gains. One of the most prominent economic stakeholder in the sea is hydrocarbon operations that procure financial and political power to the countries while threatening biodiversity and ecological life of marine areas (Mazor et al., 2014). The drilling activities on maritime areas may cause various forms of contamination that lead significant effects on water and other wildlife. There are many scientific studies that prove these negative impacts in this field. According to American organization Oceana which is founded for protecting and restoring the world's oceans on a global scale, the negative effects of oil drilling constitutes of brine wastes, drilling muds, pipeline leaks and deck runoff water and flow line. Moreover offshore drilling operations cause catastrophic spills together with threatening human health. These effects can be detailed as below (www.usa.oceana.org):

- Produced Water's Effects: Produced water is defined as trapped underground and carried out with oil and gas. This water includes oil content of 30 to 40 parts per million. The studies show that approximately 2 billion gallons produced water leaked in Alaska every year and it contains nearly 70,000 gallons of oil.
- Drilling Muds' Effects: The drilling muds that are being used in oil operations release toxic chemicals and they have catastrophic effects on marine life. Normally one drilling platform discharges nearly 90,000 metric tons of drilling fluids into the ocean.
- Offshore Oil Rigs' Effects: The lighting and flaring of offshore oil rigs take the attentions of seabirds and fish come together near them. The studies show that mortality of birds are associated with oil leaks and flaring of oil rigs. This flare process causes burning of fossil fuels and this process produces black carbon that effects the climate change negatively.

- Exploration's Effects: Offshore oil necessitates of firing air guns and these guns transmit very powerful shocks over the seabed. These process may lead decreasing fish catch, harm various marine species' hearing ability and cause the stranding of marine mammal.

On the other hand, all of these activities can extend over 2 km. However, the ecological effects at the community levels and population on the seafloor are usually about 200-300 meters from the source. Moreover, these negative effects can remain in deep sea for many years and may possibly last longer for more fragile ecosystems as cold-water corals (Cordes et al., 2016). Figure 1 shows the detrimental environmental impacts of oil and gas activities in a detailed manner. The exploration process have directly physical disturbance effects as drill cuttings, anchor chains and drilling fluids and indirectly effects as traffic and sound. Then the production process such as increasing of produced water and laying of pipelines affects the marine areas. Finally, bringing up oil has a contaminating influence on marine environment (Cordes et al., 2016).

Apart from these, seismic exploration for discovering potential reservoirs effects marine areas before starting of deep-water oil and gas development activities. In this phase rising density of vessel activity, light emissions and underwater sound have negative effects on sea. These detrimental impacts constitutes of behavior disruption, physiological stress, hearing damage and localized displacement (Cordes et al., 2016).

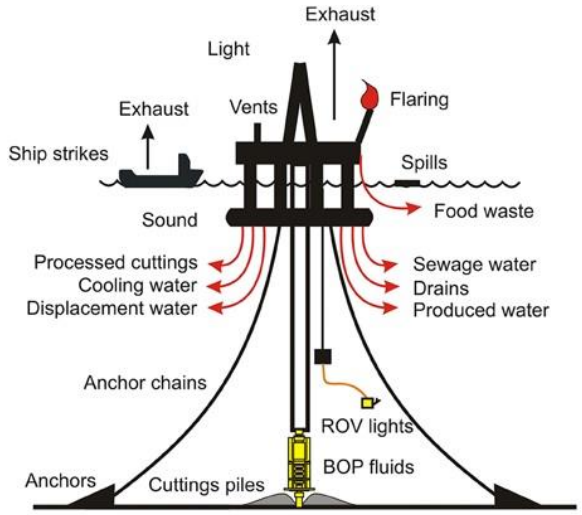
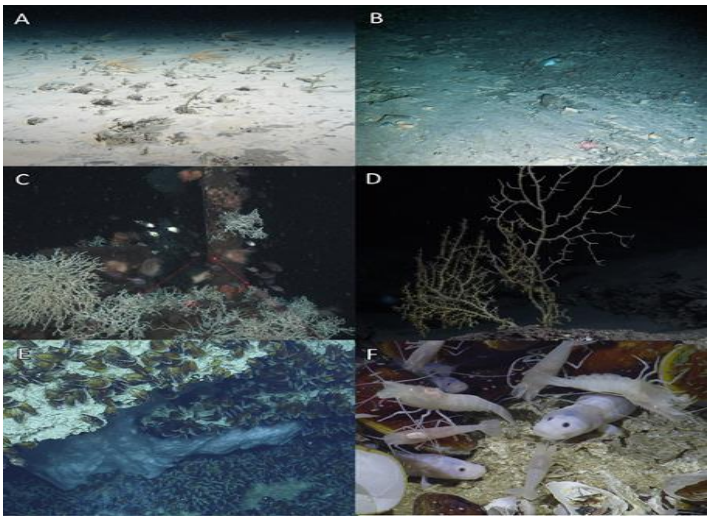


Figure 1: *Effects of Deep-Sea Drilling Activity*

Source: Cordes et al., 2016

Furthermore, petroleum drilling activities and the discharging of sediments may influence corals. The previous researches related with drill cuttings showed that these kind of activities result with reduced growth of corals (Mortensen et.al, 2015). Some of the numerous impact of the activities on cold water corals have been shown in Figure 2 together with explanations of pictures on A,B,C,D,E and F.



Deep-sea communities near drilling activities. (A) Benthic communities shortly after smothering by (light colored) cuttings at the Tornado Field (1050 m depth), Faroe-Shetland Channel, UK. **(B)** Edge of cuttings pile at the Laggan field, Faroe-Shetland Channel, UK **(C)** Atlantic roughy, Hoplostethus occidentalis, among *L. pertusa* around the abandoned test-pile near Zinc at 450 m depth in the Gulf of Mexico. Image courtesy of the Lophelia II program, US Bureau of Ocean Energy and Management and NOAA Office of Ocean Exploraiton and Research. **(D)** Appearance in 2013 of a *Paramuricea biscaya* colony damaged during the Deepwater Horizon oil spill in 2010. Image courtesy of ECOGIG, a GoMRI-funded research consortium and the Ocean Exploration Trust. **(E,F)**: Methane-seep communities from an area within the exclusive economic zone of Trinidad and Tobago that is targeted for future oil and gas development.

Figure 2: *Deep Sea Communities near Drilling Activities*
Source: Cordes et al., 2016

3 THE PROMINENT OIL DRILLING CASES IN WORLD SEAS

Due to the fast growing world population and reduction of scarce resources, the attentions of nations have been shifted to the marine related resources as exploring, drilling and transferring oil in maritime areas. These activities, on the one hand bring wealth to the nations, on the other hand, they impair marine environment, nature, people and other living things largely. Although there are numerous examples of these damages on the world scale, only the most known examples from around the world are included in this study. The more exploration of oil and gas activities increased, the resources became depleted and the industry expanded into deeper waters. The main maritime areas have shown in Figure 3. Moreover, these deep-water activities always do not correspond with modern environmental legislation (Cordes et al., 2016).

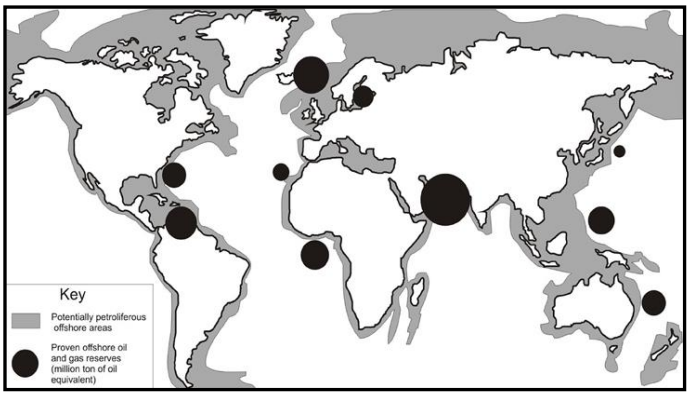


Figure 3: *Potentially Petrolifeorous Offshore Zones and Proven Offshore Oil and Gas Reserves*
Source: Cordes et al., 2016

Oil and gas exploration in maritime areas has commenced in 1897 and oil firstly produced in Summerland, California. Together with offshore drilling technology, the discovery of large hydrocarbons reserves from the deeper offshore areas has started in by the 1960s. Today, offshore oil and gas drilling activities are being continued in major deep water (>200 m) areas as North Atlantic Ocean, East and West Africa Gulf of Mexico, Arctic, Southeast Asia, South America, Australia, and India (Figure 3). However, ultra-deep water production which is more than 1000 m is expected to be increased in the forthcoming years (Cordes et al., 2016). In addition to these, one of the world's minimum explored oceans is Arctic. Furthermore, the Gulf of Mexico has already been a web of pipelines and wells although leakage of million barrels oil from BP Deepwater Horizon disaster in 2010 (news.nationalgeographic.com). In spite of all major events, oil exploration activities in risky areas around the world have continued at full speed. Although there were countless incidents in the world, which resulted in great damage, only the primary cases were included in this study and explained in detail as below.

3.1 **Deepwater Horizon**

Deepwater Horizon case, which is known as BP Oil Spill and Gulf of Mexico Oil Spill in 2010, is regarded as World petroleum industry's largest oil spill in the history. The 11 crew members was killed and 17 crew members were injured in this incident while it was causing thousands of people's serious health risks (see, Figure 4). Moreover, the incident did not influence not only people, but also created huge damages on wildlife habitats together with tourism industries and fishing activities. During drilling 5,100 ft of water, methane gas has emerged and expanded into the grilling rid and started to ignite. Then ıt was caused a giant fireball and damaged the oil pipeline to the rig (Kanso et al., 2019).

Figure 4: *Location of the Deepwater Horizon*
Source: Kanso et. al., 2019

Approximately over 4.9 million barrels of oil has spilled during several months because of the explosion and oil leak (see Figure 5). This oil spill costed widely damage on environment and made thousands of kilometers of coastal land uninhabitable for hundreds of indigenous species. In addition, approximately 143 spill-exposure cases reported in Louisiana posed health risks for the local population (Kanso et. al., 2019).

Figure 5: *Deepwater Horizon offshore drilling unit on fire in 2010.*
Source: Kanso et. al., 2019

The damage of this oil spill on the marine environment has remarkable effects. The Centre for Biological Diversity announced that this accident killed 25.900 marine mammals, 82.000 birds, 6.000 sea turtles and thousands of fish (www.marineinsight.com).

3.2. Ixtoc 1 Oil Well

The most disastrous oil spill the western hemisphere has ever witnessed occurred during the 10 months between June 1979 and March 1980, when the experimental well IXTOC I blew out off the coast of Mexico's Yucatan Peninsula. The beaches of Mexico's eastern shore suffered the heaviest contamination from the spill while containment efforts and fortunate weather saved the United States' Gulf Coast from the severe contamination many feared, but the combination of dirty

beaches and media coverage brought about many tragic economic impacts (Myer, 1984). The water depth at the site is about 50 m. The drilling continued through the first part of 1979 and by the end of May a depth of 3600 meters had been reached. Early on June 2 at a depth of 3615 meters, the well started to loose drilling mud; circulation was totally lost about 3625 meters. Several unsuccessful attempts were made to regain circulation, but as the well appeared stable, it was decided to seal it by withdrawing the drill pipe and inserting a plug in the empty space. On June 3, during the attempts to seal the well, the extremely high pressure (about 350 kg/cm2) caused mud to flow up the drill pipe and onto the platform. At 3:30 am the well blew out and caught fire. The explosion and fire destroyed the platform, which sank to the bottom and damaged the stack and well casing. This allowed the oil and gas to mix with water close to the sea floor, beginning the largest marine oil spill in the history of oil exploration (Jernelöv, Lindén, 1981).

Figure 6: *Ixtoc I Oil Case*
Source: Jernelöv, Lindén, 1981

The initial rate of flow from the unattended well was estimated by most creditable sources as 30,000 barrels/day (1,260,000 gallons/day) for the first two months of the spil1. By the end of February 1980 two relief wells had been completed and Mexican authorities claimed the leakage rate to be less than 2,000 barrels/day 6. Furthermore on March 5, 1980, the New York Times reported the flow rate as negligible and capping operations nearing completion (Myer, 1984). Due to the relatively short period of heavy oiling, the protection of the Laguna Madre, and the natural resilience of the resources of the area, damage to South Texas' marine wildlife from IXTOC I was lighter than most had expected. In its 1981 summary of biological studies, the National Oceanic and Atmospheric Administration (NOAA) listed the results of survey after survey as minor or insignificant. In the in1ets and 1agoons, the only significant oil impact observed was the oiling of a marsh for 10 days, which "did not immediately inhibit photosynthesis or respiration of representative nearshore plankton samples and seagrasses." On the sand beaches, NOAA found that the migratory birds instinctively avoided the more heavily oiled beaches, and "Ground observations of wading and shorebirds indicated that the oiled birds never exceeded 10%, peaking during periods of heaviest oiling. Though populations of crabs and other beach in fauna were significantly reduced along the intertidal zones, it was pointed out that lilt was difficult to distinguish the effects of the oil spill from natural factors, especially storms and natural population variations (Myer, 1984).

3.3 Nowruz Oil Field Spill

In 1983, an oil tanker hit the Nowruz field platform in the Persian Gulf and the damage caused a huge oil spill. In the seven - month period after the accident, approximately 80 million gallons of oil-per day is estimated to spill about 1500 barrels into the Persian Gulf (www.marineinsight.com).

Figure 7: *Nowruz Oil Field Spill*
Source: www.brasil.campusvirtualsp.org

As in all major oil spills, ecological damage, with main economic impact on the fishing industry has occurred also in this case. According to Saudi Arabia's University of Petroleum and Minerals Research Institute, Gulf waters off parts of Saudi Arabia was devoid of any sea life. As same, Kuwait Institute of Scientific Research has reported an unusual absence of fish in areas near normally productive coral reefs. The immediate threat from the oil spill is to the weather supplies of the western Gulf States. All rely heavily for their fresh water on coastal facilities that desalinate seawater. These plants cannot operate when oil mixes with intake water to clog filtration systems. Oil that enters the distillation unit is not removed from the water, causing damage to the plant's equipment and giving the desalted water an oily content (www.cia.gov) The biological impacts of the accident were undisputedly excessive. From the 50 dugongs (sea cows) of 31 were killed in the Gulf of Salwa because of the oil spill. According to a report by World Wildlife Federation (WWF), on the Saudi Coast more than 100 dead sea turtles was found after accident. It is difficult to estimate how many have died because of the oil spill, but many thousands of Sea Snakes were observed dead in the Gulf. The oil on the islands' shores has also affected birds. Hundreds of birds were found dead, and a large number were too oily to fly. Others showed flight impairment and some birds suffered the loss of primary and secondary flight feathers. Field trips were conducted to the islands from early April to September and on each occasion, disabled birds were found because of oil on the shores. Coral Reefs on Karan Island are the most important reef system in the Gulf, and these were severely affected by the oil. The reefs were almost totally killed to at least a six meter depth, and the same was found on Jana Island. The reefs on Jurayd Island

were also affected but less severely (AI-Amirah, 1980).

3.4. Exxon Valdez Oil Spill

The Exxon Valdez tanker struck a reef in Prince William Sound, Alaska, and spilled approximately 11 million gallons of crude oil in 1989. This accident was the biggest spill in U.S. waters until the Deepwater Horizon case. The oil spill killed numerous fish, marine mammals and seabirds while destroying mainstay of people in the region. The company Exxon spent $150 million criminal fine, $900 million to settle civil claims, $100 million to criminal restitution and approximately $2.1 billion for cleanup (Deep Water Report, 2011). After the accident, out of the total capacity of 58 million gallons, 10.9 million gallons were moved into Alaskan Coastline. Because of the accident, marine species were affected calamitously and approximately 300 harbor seals, 2800 sea otters and 250,000 seabirds were killed. Besides, fishing and tourism industry also were affected in ill part (www.marineinsight.com).

Figure 8: *Exxon Valdez Oil Spill*
Source: Deep Water Report, 2011.

4 CONCLUSION

As long as there is a search for resources in the world, the exploration activities for oil and petroleum will continue. The problem is that while they are contributing wealth to the nations in one hand, on the other hand these activities have calamitously impacts on nature, people, marine environment and other living things. However, the extent to which these activities continue to harm the marine environment, nature and people depends on the careful work on this subject. In the gas production and deep-sea oil areas, a comprehensive management and organization plan together with scientific and ecological research is needed in order to avoid accidents and destroying the nature. It is a well-known fact that it is difficult to decide about the future without knowing the past. That is why, firstly all the events related to oil drilling activities should be investigated with all details. Thereafter major accidents and their grave consequences should be evaluated with cause and effect relationships by identifying common problems in all accidents. In this respect, major accidents and their consequences related to oil drilling activities are included in the scope of this study. These important accidents are brought to the agenda by taking into consideration the measures to be taken in the future. In this sense, the number of similar studies should be increased and the problems that may occur in the future oil drilling activities should be minimized.

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