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SHIPPING RISK ASSESSMENT: A CASE STUDY FOR GREEK WATERS

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SUMMARY: The Greek seas are vital for shipping, tourism revenue and fishing, while supporting a biodiversity hotspot of international importance. Yet, Greece has not put any measures in place to safeguard its marine resources from maritime accidents. The introduction of measures to protect national wealth, tourism, fisheries, and public health through maritime management is essential. Selected maritime accidents that have taken place in Greece are examined along with the various impacts these accidents have on humans and the marine ecosystem. Best practices from other countries are explored and used alongside the knowledge gained from the case studies to better assess potential regulation suggestions and improvements for Greece, with the aim to better protect its waters for shipping, marine life and local communities. Designated shipping lanes for Greek waters, a maritime traffic control system and Particularly Sensitive Sea Area status from the International Maritime Organization would bring Greece in line with other major shipping areas like the Baltic region, the United Kingdom and the Strait of Istanbul. The introduction of efficient measures for the prevention and management of potential shipping accidents is of grave importance, as catastrophic events could have long-term, irreversible impacts on human and marine health.

1. INTRODUCTION

The shipping industry in Greece is renowned throughout the world. Currently, over 230,000 out of Greece's 10 million inhabitants work directly in the shipping industry or related maritime activities (European Commission, 2018). Oil and cargo shipping directly benefits Greece as well as the world's shipping industry. However, the integrity of the Greek Seas is extremely vulnerable to the impacts of human based activities, including shipping. The growth in shipping increases the amount of marine pollution caused by certain maritime activities. The marine ecosystem supports a large part of the Greece national wealth. It is highly dynamic and vital for marine protected and endangered species as well as the economic, scientific and cultural sectors. These benefits should not occur at the expense of the marine wealth and biodiversity as it has negative socio-economic impacts on sectors, such as fisheries and tourism, that heavily depend on the clean waters (Moller, et al., 2003). If pollution levels increase, or a shipping disaster occurs, the results could be devastating and long lasting, surpassing any economic gains from shipping transport activities in the region.

Currently, the shipping accident response mechanism in Greece is inefficient. Due to the ineffective regulatory system currently in place, shipping regulations must be improved and enforced to protect the marine ecosystems in the Greek Seas. In this paper, local Greek maritime accidents will be examined along with the various impacts these accidents have caused on humans and the marine ecosystems. Best practices from other countries will be explored and used alongside the knowledge gained from the case studies to better assess potential regulation suggestions and improvements for Greece to protect more efficiently the surrounding waters for shipping, marine life and local communities.

2. SELECTED ACCIDENTS IN GREEK WATERS

The following incidents are just a selection of maritime accidents that have occurred recently in Greek waters and clearly demonstrate the lack of an efficient mechanism to prevent and respond to maritime accidents. Between 2011 and 2016, the HBMCI investigated more than 800 incidents. With Greek waters being such a busy shipping area, it is remarkable that there has not been a more catastrophic maritime accident yet. The cleanup efforts can be extremely costly and the recovery for the marine ecosystem, birds, turtles and marine mammals is slow (Smith, 2017), while the impact of a major accident to tourism, fisheries and public health can be devastating and long-term. Taking this into account, the establishment of efficient prevention and response mechanisms for maritime accidents would be more cost-effective for the Greek government, rather than dealing with the long-term consequences of a catastrophic event.

2.1. *Sea Diamond*

In April 2007, the cruise ship *Sea Diamond* hit a reef off Santorini, Greece and, instead of being salvaged and following a series of inappropriate practices, it was moved over deeper waters and allowed to sink to a depth of 100-130 meters (Guest, 2012). The ship contained 550 tons of heavy oil and lubricants, as well as a large amount of other toxic compounds contained onboard (e.g. batteries, screens, halogen lamps, cables, etc.). Eleven years later, it is estimated that over 330 tons of heavy oil and lubricants are still trapped within the wreck, along with the other toxic compounds that are gradually leaking from the vessel into the marine environment. It took 9 years for the legal process of the civil case to be completed and the Greek Merchant Marine Ministry recently ordered the raising of the vessel due to the environmental risks and hazards it poses to shipping. However, as the criminal case is still pending, it is still unclear who will finance its removal and the wreck remains on the sea floor (Fox News, 2017; Guest, 2012). Between 2009 and 2016, seawater, sediment and fish tissue samples were taken near the wreckage and analyzed for levels of copper, cadmium, lead, nickel, chromium, zinc and mercury, which concluded that the wreck appeared to have a 25-30% chance of presenting adverse toxic effects due to the presence of heavy metals (Hahladakis & Gidarakos, 2016).

2.2. *Katherine/Baru Satu* collision

In July 2013, the bulk carrier *Katherine* passed through the Kafirea Strait while the bulk carrier *Baru Satu* was travelling toward the Kafirea Strait at the same time. The vessels were unable to connect and confirm their intentions of passing, which would have required an alteration in course. The two vessels collided, both sustaining damages (HBMCI, 2014). The Kafirea Strait is the busiest passage for shipping traffic in Greece, leading to and from the port of Piraeus.

2.3. *Yusuf Cepnioglu*

Less than a year later, in March 2014, *Yusuf Cepnioglu* was passing through the Aegean Sea with the intention of travelling between Mykonos and Tinos islands. While on watch, the chief officer fell asleep and missed the waypoint to alter the course and as a result, the vessel grounded with its bow on the bay of Avlemonas on the northern coast of Mykonos. *Yusuf Cepnioglu* suffered multiple cracks and deformations to the bow and port side, resulting in cargo containers detaching into the water and polluting the surrounding area. The ship was removed in two pieces, the cargo containers were recovered, and the onshore pollution was removed (HBMCI, 2015).

2.4. *Goodfaith and Kerem S*

Goodfaith grounded on the Northwest seafront of Andros Island in February 2015 after it attempted to travel through the Kafirea Strait during Beaufort 8 and 9 conditions. The Hellenic Bureau for Marine Casualties Investigation (HBMCI) reported limited pollution but the full report is not publicly available to determine the actual amount (HBMCI, 2016). During the same month, the general cargo ship *Kerem S* had planned to travel between Ikaria and Samos Islands, before anchoring off Thymaina due to heavy winds and strong swell. The winds pushed the vessel on the rocks where the propeller was damaged, and the rudder was dislodged. The master did not report the incident, instead he used the bow thrusters to refloat the vessel to attempt to avoid more damage. The vessel then started to drift at a rate of 2 knots at which point the master contacted the managing company. While waiting for assistance, the master put down the anchor off the northern coast of Levitha islet, but the strong current and wind pushed the vessel on to the rocks where substantial damage occurred (HBMCI, 2016).

2.5. *Agia Zoni II*

In September 2017, the small tanker *Agia Zoni II* was carrying 2,500 tons of fuel oil and marine gas when it sank off Salamina Island. More than 2,000 tons of fuel was released into the marine environment, polluting beaches and coastline along Salamina, Athens, and Selinia (Keep Talking Greece, 2017). A salvage company removed the sunken vessel to avoid further oil and chemical spills by removing the wreck from the marine environment (Naftemporiki.gr, 2017).

3. IMPACTS

Maritime accidents impact a myriad of sectors including tourism, fishing, public health, and marine life. Tourism is a major sector for the Greek working industry, consisting of 860,500 jobs and compensating for approximately 18% of the country's GDP (World Travel & Tourism Council, 2017).

3.1. Tourism

The tourism sector is highly dependent on a clean and attractive environment. A large number of tourists come to Greece for its uniquely beautiful island climates, pristine blue swimming waters and clean beaches. Popular activities include travel between islands, beach holidays, cruises and recreational activities such as sailing, diving and snorkeling. Pollution in the Greek waters, as well as oil spills by tankers, could ruin Greece's reputation as a top island and beach destination for tourists. With so much value being placed in the tourism industry, it is important to ensure that the waters are clean and protected.

3.2. Fisheries

Fisheries are another important industry in Greece, employing approximately 38,151 people in 2005, landing 118,634 tons of fish amounting to 399 million euros (European Commission, 2018). Additionally, small scale fishing activities provide subsistence to thousands of Greeks who maintain traditional ways of living on the islands. Local tavernas depend on these fishermen to provide fish for their restaurants on the Greek islands, thereby creating structures of dependencies within the local communities and economies. Many of the methods of fishing used by local fishermen have been passed on from generation to generation and, in turn, represent local traditions and cultures. Subsistence fishermen are already witnessing diminishing fish stocks, and each year it becomes harder for them to catch enough fish to securely make a living. Having to close down fisheries because of marine pollution would equate to thousands of people losing their only means of subsistence.

3.3. Public Health

In the immediate aftermath of an oil spill, health issues arise due to the toxins released. Whether hiring personnel to carry out the cleanup work, or using volunteers to help, there is a definite requirement for personal protective equipment and appropriate training. Cleanup crews and residents of the affected area complain of: skin lesions, wheezing, shortness of breath, coughing, and phlegm (Laffon, et al., 2016). Physical health is not the only area that is impacted following an oil spill; mental health was also negatively affected in terms of anxiety, depression, stress and post-traumatic stress disorder, with anxiety and stress being more highly recorded in areas where the family income was directly affected by shipping and fishing industries. Additionally, negative behavioral changes were recognized among adolescents when compared to their behavior in previous years (Laffon, et al., 2016). These mental health issues require counseling and support, putting further strain on the economy.

3.4. Cultural Heritage

The Greek waters is one of the wealthiest regions in the world in terms of cultural heritage and ancient archaeological sites. There are four UNESCO protected sites, located on the islands of Patmos, Chios, Samos and Rhodes (UNESCO, 2018). Also, many ancient shipwrecks and cities lie on the floor of the Aegean Sea. Many of Greece's historical treasures are still lying on the sea bed, waiting to be discovered. It is impossible to place a value on these sites and ruins given their unique and irreplaceable nature and the number of discoveries yet to be made. A major oil spill or other environmental disaster could damage and even destroy underwater archeological sites and cultural treasures.

3.5. Marine Life

The Greek seas are important areas for marine life as they are home to many species including the endangered Mediterranean Monk Seal (*Monachus monachus*) with fewer than 600 individuals left (Johnson & Karamanlidis, 2017). There are 6 cetacean and 3 turtle species that are present in Greek waters (IUCN, 2018). However, these species are declining; the sperm whale, common dolphin, harbor porpoise and green turtle are considered endangered and the common bottlenose and striped dolphin are considered vulnerable (IUCN, 2018). In addition, there are 77 species of sharks, rays and chimaeras in the Mediterranean Sea, three of which are endemic to the area; 40% of the shark species are considered endangered (Conrad, 2012; Dulvy, et al., 2016). Greece is also the main spawning ground for the eastern Atlantic bluefin tuna (*Thunnus thynnus*) and home to the endangered seagrass species *Posidonia oceanica* which is protected under the Barcelona Convention Annex II and is

included in the Bern Convention under Annex I (Coll, et al., 2010; Pergent, et al., 2016). The many thousands of marine species found in Greek seas serve an important role in Greece's ecology and are connected through the food chain, all the way up to human consumption. Therefore, these species need to be protected efficiently to ensure that the industries that rely on the marine life, like tourism and fishing, are able to continue.

4. BEST PRACTICES OF OTHER COUNTRIES

4.1. The United Kingdom

The United Kingdom has 3 specific pieces of legislation that protect their marine environment: The Merchant Shipping Act of 1995, The Merchant Shipping (Prevention of Oil Pollution) Regulations of 1996, and The Merchant Shipping (Pollution) Act of 2006. The Merchant Shipping Act of 1995 increases the effective response to oil pollution incidents; it is applicable to ships and offshore installations and ensures that operators have an Oil Pollution Emergency Plan in place (UK Legislation, 1995). The Merchant Shipping (Prevention of Oil Pollution) Regulation of 1996 covers all UK tankers of 150 GRT and all foreign ships of 400 GRT to ensure that they carry a Shipboard Oil Pollution Emergency Plan approved by the Maritime and Coastguard Agency. Additionally, it clarifies where tankers can discharge oil or oily mixtures in the sea (UK Legislation, 1996). The Merchant Shipping (Pollution) Act of 2006 details the ability to claim compensation for oil pollution from ships and also ratifies Annex VI of the MARPOL convention (UK Legislation, 2006). Furthermore, the UK currently has 50 designated Marine Conservation Zones, roughly 11 of these are located within the English Channel, designed to ensure the marine environment is clean, healthy, safe, productive and biologically diverse (JNCC, 2016).

4.2. The Baltic Region

In 1992, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, Sweden and the EEC signed the Helsinki Convention to create shipping regulations to protect the marine environment in the Baltic Region. It was agreed that in the event of pollution, the contracting parties would ensure that the polluter pays and that any abandoned, disused or accidentally wrecked offshore units were entirely removed under the responsibility of the owner (Helsinki Convention, 1993). It is a live agreement that allows for the opportunity to amend and improve, should it be required. In addition to the Helsinki Convention, there are 174 HELCOM Marine Protected Areas within the Baltic Sea. These areas are specific to coastal and marine habitats of particular ecological significance that may have a high proportion of migratory species, high sensitivity, or are important feeding, breeding, or nursing grounds. Each site has a unique management plan pertaining to human activities in the specified area (HELCOM, 2018). Another important element of HELCOM is the Seatrack Web oil drift system that can be used for forecasting particle movement like oil, to predict where the recovery resources will be most beneficial. It can also be used in hindsight to identify which vessels have passed through the track of the oil and therefore help identify the culprit of the spill (HELCOM, 2018).

4.3. The Strait of Istanbul

The Strait of Istanbul is currently utilizing a marine traffic control system, known as the Vessel Traffic Service which began operating in 2003 (Pizon, 2018). In 1994, a traffic separation scheme was approved by the IMO and Turkey was given the authority to suspend one-way or two-way traffic in order to allow for safe passage of large vessels (Pizon, 2018). The Turkish Strait's Vessel Traffic

Service is able to aid vessels through the strait by using 13 towers that give the vessel traffic situation (Pizon, 2018). Each tower has an X-band radar and remote-controlled TV camera, which sends data to the main center (Pizon, 2018). The traffic controllers and captains help ships that are suffering from navigational equipment failure and organize ship traffic before they enter the strait (Pizon, 2018).

5. DISCUSSION

The aforementioned accidents in Greek waters, generally result from human error and could have been avoided with the implementation of efficient management and accident prevention measures, such as regulated shipping lanes and a traffic control system. One of the most beneficial changes to put in place and thereby avoid accidents should be designated shipping lanes and no entry areas within Greek waters. If a strong control system was established in the Kafirea Strait, the collision between *Katherine* and *Baru Satu* or the grounding of *Goodfaith* wouldn't have occurred. Another measure to put in place would be a traffic control system. With so many islands making up the Greece archipelago, it is possible that systematically placed radar towers could service the entire area. They could help with traffic management, alerting ships when they are off course and ensuring that the destination port has the facilities required to fully service the vessel. A traffic control system could have prevented the accidents of *Yusuf Cepnioglu* and alerted *Katherine* and *Baru Satu* of their impending collision.

One of the most important advancements in this area is the International Maritime Organization's (IMO) *Particularly Sensitive Sea Area* (PSSA) designation, with Associated Protected Measures (APMs) implemented. To date, 11 bodies of water around the world have been given PSSA status, with the implementation of APMs such as: traffic separation schemes, deep water routes, areas to be avoided, mandatory ship reporting, MARPOL special areas and localized compulsory pilotage. Such measures are welcomed not only by environmentalists but also shipowners because they reduce risks of collisions and catastrophes and thus avoid unnecessary financial costs and negative press. As previously stated, Greek waters experience heavy maritime traffic, so an IMO PSSA would be the ideally addition to safeguard the shipping lanes and protect the marine environment. The measures proposed endure the reason to avoid accidents, to ensure environmental protection and allow the shipping areas to remain open, since Greece is one of the busiest shipping areas in the world (Miliou, et al., 2010).

6. CONCLUSION

In conclusion, all of the above activities and sectors in Greece necessitate the preservation and protection of the environmental conditions. High pollution levels in the Greek waters could easily devastate tourism by fouling waters for swimming and recreation and also could result in unattractive beaches for visitors. Greece must uphold its international obligations to preserve and protect the endangered and protected habitats and species residing in its waters. If not, this could put the country in violation of UN, EU and other international laws (Akten, 2006). Greece should create and enforce measures to regulate the busy shipping area around the archipelago.

If Greece wants to continue utilizing the sea for tourism, fishing and cargo transportation, then measures need to be applied to protect the environment from a potential maritime accident. This can be done by learning from past accidents combine with international experience to determine proper protocols to prevent and react to an oil spill. A large disaster could eradicate many marine life species and ecosystems, destroy biodiversity, and devastate economic activities. Other major shipping areas

like the Baltic states and the UK already have protective measures, while Istanbul is protecting their narrow passage ways through an efficient monitoring and control system.

While it seems like marine environmental health and a flourishing shipping industry could never coexist in Greece, there are numerous examples of state action to protect ecosystems and preserve shipping simultaneously. Countries that prioritize the protection of their marine resources have and continue to implement shipping regulations and best practices that work not to impede shipping activities in their waters, but to also protect marine ecosystems existing within them. Successful implementation of shipping and navigation measures in various seas around the world have shown that the two (environmental marine protection and shipping) can coexist, with favorable results at both ends.

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