Water Pollution Caused by Collision and Its Impact on The Marine Environment

Irma Rachmawati Maruf
Faculty of Law, Universitas Pasundan, Bandung, Indonesia
irma.rachmawati@unpas.ac.id

Abstract. Shipping collisions are unanticipated occurrences that cause financial loss, property damage, and the loss of persons and commodities. They can occur for a variety of reasons, including human error, technical malfunctions, environmental factors, shipping factors, and route conditions.. Marine casualties incidents in the maritime industry are unavoidable, using innovative and inventive technology against the shipping industry through thread execution of standards and precautions for safety. This research aims to investigate the effects of shipping accidents on the marine environment in the Malacca Straits. The methodology used is to analyze the critical provision of relevant laws impacted upon the marine environment fulfills the requirements for analytical description. The research was carried out using legal resources through fieldwork and library research, and it was then analyzed using qualitative techniques. Two conditions are disclosed as a result of the research findings. First, there are a number of causes for maritime accidents, including weather conditions, ship technical issues, navigation, and route circumstances; Factors relating to cargo, including hefty and hazardous cargo. Secondly, Shipping Collisions pose a growing threat to the environment, with catastrophic consequences for all stakeholders regarding human lives, the environment, and economic losses.

Keywords: Shipping Collision, Marine Environment, Oil Spill, Marine Casualty, fisheries

1 Introduction

The shipping industry carries out most world trading (Gokce Cicek Ceyhun:2014); therefore, shipping must have a method of commercial transport that is safe, affordable, and ecologically friendly. Despite the fact that more incidents bring mishaps to the public's attention, statistics indicate a continuous decrease in marine accidents over the previous ten years. (Maruf, I. R., & Supardi, E. J.:2019). In the last 20 years, restrictions have been strengthened in the highly regulated industry of shipping. Un-

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expected occurrences like shipping accidents cause property damage, financial loss, and even fatalities. (Sinanaj, S.:2020). In its international treaties, the International Maritime Organization (IMO) devoted special consideration to specific faults, technological failures, weather circumstances, shipping factors, and route- and cargo-related issues. Even IMO passed some resolutions over the last decade in the new regulations of the shipping industry to improve its safety (Chauvin, Lardjane, Morel & Clostermann, 2013, p.26).

Marine accidents have a harmful impact on people, the marine environment, property, and activities both on board ships and ashore to varied degrees. (Zang.B., et.all, 2019) Casualties can result in everything from small accidents to fatalities, as well as modest to major environmental and property damage. A sizeable amount of transportation expenses is attributable to the cost of accidents, which includes the cost of fatalities and injuries, property damage, ecological harm, preventative and mitigating actions, and insurance. (Mullai & Paulsson, 2011, p.1590). Every seafarer's worst dread is a maritime accident, no matter how it occurs in nature. Several significant concerns are likely to be encountered should it take place in a limited space, such as a channel or strait with considerable traffic. On the other hand, a severe shipping accident can deteriorate if water enters the ship, for example, which could aggravate the damage stability of the ship if it is compounded by bad weather or a strong current. However, in some other catastrophes, the problem is more "environmental" because of an oil spill. (Akten & Gonencgil, 2002).

The marine environment is impacted by shipping accidents in a variety of ways. The causes of maritime pollution are collisions and accidents, but human error such as oil spills, solid waste, oil transfers, or unintentional bunkering can also result in marine pollution. (Deja, A.et. all, 2021) . As a result, this study assessed statistics on maritime mishaps and marine pollution caused by ship collisions, particularly in the Malacca Straits.

The Strait was historically an important trade route between India and China, and its strategic location made it a hub for commerce and cultural exchange. It has been the subject of territorial disputes between Malaysia, Indonesia, and Singapore (Warren, J. F.,2007). The length of the Strait is approximately 500 miles, and its width varies between 1.5 and 75 miles. (Gholizadeh, A., 2020). It is a strategic chokepoint through which most of the world's maritime commerce passes, including Middle Eastern oil bound for East Asia. To prevent piracy and secure the safety of shipping. The naval vessels from numerous countries heavily patrol the straits due to this condition

The natural conditions of Malacca Straits can make shipping activities hazardous since it is located primarily outside of the tropical cyclone zone. (Zhou, L.,2020). The violent winds and storm surges that frequently result in tragic loss of life in neighboring countries rarely affect coastal regions. A localized storm at sea could be disastrous for maritime vessels otherwise. The size of the sea body and the erratic monsoon cycle brought on by Indonesia's vast island dispersal are the primary determinants of its climate. (Xu, S.,2020). Many of its oceans are prone to natural disasters because of the region's geological instability. The dangers of shipwreck due to storm or reef, or merely individual misfortune, are more significant at sea than on land. More complex-

ly, it refers to having advanced knowledge of the sea, such as reading the ocean, spotting an underwater danger, such a reef, or foreseeing a change in the wind or cyclone's approach (Lam, J. S. L., 2017). Strong currents and wind typically cause collisions in the straits. Consequently, specific sea routes in the waters may contain hazardous natural conditions for ship safety.

Liability for goods and people is a result of an accident. Pollution is the most serious impact on the ocean because chemical waste and oil waste are discharged from ships into the water. For many years, the International Maritime Organization (IMO) and other maritime organizations focused on finding practical solutions to lessen collisions. According to data, 60 percent of collisions that occur in ports and at sea result in environmental harm. Even large ships are seven times more likely to pollute than tankers. (Konstantinos Giziakis and Ernestine Bardi-Giziaki,2012). In certain instances, in addition to the pollution of the sea, shipping channels are disrupted because the owner has not removed the dead vessel. In addition to being fatal for the ships, their goods, crew members, and passengers, collisions can also have a negative effect on the ecosystem at sea, as was the case with the MV Nakhoda and MV Prestige. (Przywarty, M., (2015). The case concerns the risk assessment of a collision in the western Baltic Sea between a passenger ferry and a chemical tanker.

2 Literature Review

According to UNCLOS, "Pollution of the marine environment" is defined as "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, a hazard to human health, a hindrance to marine activities, including fishing and other legitimate uses of the sea, impairments of quality for the human population, or the release of contaminants into the environment." The four negative impacts listed below—one or all—will probably result from the pollution: I endanger living things, ii present health risks, iii hinder marine operations (such as fishing), degrade the quality of seawater, and reduce amenities. According to the definition, the author made the assumption that pollution is the introduction of pollutants into the marine environment. This clause requires three succinct comments. (Patricia Birnoe,2021) First of all, this is a broad term that might include all sources of marine pollution, both old and new. The concept also includes elements or chemicals that could have negative impacts. It would follow that marine living species are subject to potentially hazardous effects on the marine environment. Therefore, conserving marine species—which can also be the subject of regulation—is a necessary part of protecting the maritime ecosystem. The preservation of marine species is necessary for the preservation of the maritime ecosystem.

However, the phrase is used in other clauses because of the entrance of pollutants. The absorptive and carrying capacities of the marine environment are influenced by the chemical properties of the water. These capacities are expected to decline in tandem with the rise in marine pollution from land-based sources and vessel discharge in

the straits. (Yoshifumi Tanaka,2012) As was previously indicated, there are numerous sources of marine pollution in the straits.

The disaster involving the Liberian Tanker Torrey Canyon was the first incident that made the grave seriousness of oil leaks at sea clear to the world community. (Rogowska, J., & Namieśnik, J. 2010). The Torrey Canyon incident was as much of an environmental catastrophe for many creatures as the Titanic's sinking was for people. (Duda, D., & Wawruch, R.,2017). The oil pollution brought on by this incident covered 80 kilometers of the French coast on the other side of the English Channel and 120 miles of the Cornish coast. (Rogowska, J., & Namieśnik, J. 2010). Unimaginable losses were incurred by the resident populations of sea creatures and seabirds along these coasts. It took the ecology, on average, six years to recover. However, on March 17, 1978, off the coast of Brittany, France, the Amoco Cadiz was involved in the worst tanker accident to ever take place in European waters. Due to this disaster, more than 230,000 t of oil spilled into the ocean. (Rogowska, J., & Namieśnik, J. 2010).

History shows many massive accidents; major oil spill accidents have also been reported in the Straits of Malacca and Singapore, as shown in Table 1.

Table 1 The oil spill in Malaca Strait

YEAR	CASE	POLLUTANT
January 1975,	MV Showa Maru	54,000 barrels of crude oil
October 1992	MV Nagasaki Spirit and MV Ocean Blessing collided.	crude oil 100,000 barrels
May 1999,	SS Sun Vista	14,000 barrels of fuel oil
April 2012	MV Indah Lestari	18 tons of diesel and 60 tons of toxic industrial chemicals.

In order to keep the broader world ecology in balance, the maritime environment is crucial. Without careful consideration, altering this environment would undoubtedly have negative long-term effects. Therefore, there is a lot of emphasis these days on stopping maritime pollution. However, the primary means of delivery for international trade is shipping. As billions of tons of raw materials and completed commodities are transported every day safely, economically, and without incident between ports and port terminals, it has a significant impact on human welfare. Ships operate in a hazardous environment. Even in the era of satellite navigation and precise navigation,

there are still a lot of maritime fatalities. There have been shipping mishaps despite the use of sophisticated navigational tools and improved communication systems. (Akten, 2006, p.271).

1. There could be a number of reasons why shipping accidents occur. These are outlined in general terms below. (Akten, 2006, p.272):
2. The ship or those in control of her may be affected by natural phenomena such as currents, tides, tidal streams, strong winds, decreased visibility (fog, heavy snow, and rain), storm seas, darkness, etc.
3. Technical failures are flaws inside the ship such corrosion, steering, engine, or hull failure brought on by subpar building materials or workmanship, or by shore-based installations like navigational aids.
4. Route circumstances may include navigational errors such as excessive dependence on nautical charts that are erroneous, suspicious, or based on outdated surveys, small channels with abrupt and angular windings, etc.
5. Ship-related considerations could include a ship's vulnerability, which is related to her larger size, which results in reduced maneuverability and stability, or draft restrictions.
6. Human errors may occur due to a variety of factors, such as a lack of sufficient knowledge and experience, technical incapability, poor lookout, failure to pay attention to instructions and regulations, carelessness when commanding a ship, incorrect interpretations of radar data, fatigue and lack of alertness, excessive working and resting, etc.
7. Dangerous products and heavy cargoes, namely their hazardous features (oils, chemicals, and nuclear substances), and the location or compartment in which they are stored on board ships, are the main cargo-related considerations.

In addition, most nations have rigorous restrictions in place, making it difficult for any ship or firm to escape after harming the maritime environment. (Ahmad, R., & Rachmawati, I. (2016). There are many other types of marine pollution, including the unintentional spilling of oil due to ship collisions, grounding, etc. (which is unpleasant but yet comprehensible because accidents happen in all areas of industry). The incidences of intentional pollution pose more of a problem because they speak to the attitudes of seafarers and businesses. (Manuel, M. E., 2011). For instance, all the waste oil, sewage, etc., was poured into the oceans in ancient times. All of this is now expressly forbidden, and laws forbid the discharge of these materials, particularly plastics, in the water.

3 Factor Causing Marine Pollution

3.1 Condition of The Ships

There are two types of Pollution: operational and incidental. (P. Birnie, A 2009), Regular ship operations generate operational vessel source pollution. Oil-burning diesel engines on ships discharge some oil along with their bilge water, and the fumes that are emitted via the engines' funnels eventually make their way back to the ocean. Oil, bilge water, and exhaust fumes were typically

returned to the ocean via the funnels in the early days of tanker operation. Ships have always disposed their operational waste in the water.

The sea used to be filled with garbage and clean material, but now ships discharge oily waste products including bilge water, sludge, and oil refuse. (Butt, N.,2007) Additionally, ballast water is removed from and containers are cleaned on chemical and oil tankers at sea. Tankers would frequently wash their oil containers with seawater jets in the early days of tanker operation and then dump the resulting greasy residue at sea. Consequently, a significant amount of oil that is spilled into the water is the cause of water pollution. Water purification techniques, such as load on top and crude oil washing, will be treated to minimize pollution in coastal countries. Tanks must be cleaned using high-pressure, hot-water cleaning equipment during "load on top" procedures, and the resulting oily mixtures will be put in a dedicated slop tank. Since oil is lighter than water, it eventually rises to the surface. Later, only the bottom layer of water is drained into the ocean, leaving only crude oil remaining. (Grolin, J. 2019).

The tank is cleaned using crude oil or the real cargo in the crude oil washing procedure. The oil can be turned back into useful oil and extracted with the rest of the cargo by spraying it onto the sediments that are stuck to the tank walls. This approach was required for all new crude oil vessels over 20,000 tons under Annex I of MARPOL 73/78 (regulation 13(6)). In Indonesia and across the world's oceans, the size of ships at sea has substantially expanded. Large-scale pollution is the result of this operation as a whole. (Zhang Z.,2012) This type of pollution has grown to be a major problem. It affects broad marine areas with little ship traffic as well as coastal districts near important shipping lanes. Vessel-source pollution has an effect on the maritime sector as well as fishing stocks and marine life. To lessen and control vessel-source marine pollution and protect the maritime ecosystem, the state must take action.

3.2 Natural Conditions

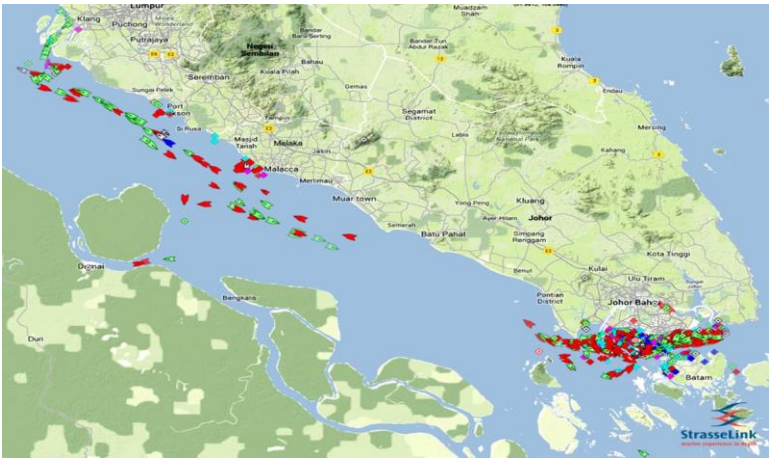
There are natural obstacles between Singapore and the Straits of Malacca. (Mohd Rusli, M. 2011).

1. Geographically speaking, the Malacca Strait separates the Malay Peninsula from the Indonesian island of Sumatra. (Nur, M.,2018) The Straits of Malacca and Singapore's Horsburgh Lighthouse are the most difficult points to navigate. One Fathom Bank situated off Port Klang in Malaysia. (Rusli, M.H.,2012) The most challenging points to navigate are Singapore's Horsburgh Lighthouse and the Straits of Malacca. One Fathom Bank is a Malaysian offshore port.
2. 2. Narrowness: The Strait is one of the world's most important traffic choke points due to its extremely short width of just two nautical miles. The Lombok, Makassar, Sibutu, and Mindoro Straits are more frequently used by enormous oil tankers due to their shallow waters (25 meters or 82 feet in various places). (You, 2010)
3. The area is frequently hit by storms and rain, and traveling across the Straits

might expose one to powerful currents. (Rusli, M.H.,2012) Visibility can significantly diminish during hurricanes and haze, making it challenging for mariners to steer their vessels.

4. Visibility: Sumatra's haze from forest and bushfires has also made it dangerous to navigate these rivers safely, and it still poses a risk to mariners today. (You, 2010) In the past, the smoke from forest and plantation fires might occasionally seriously impair vision, prompting Malaysia to issue a warning for ships traveling across the Straits of Malacca.

Fig 1. AIS capture showing the typical number of vessels transiting Malacca/Singapore Straits (Strasselink Marine Consultancy)



3.3 Density of traffic and activities

Navigational hazards result from the Straits' narrowness and heavy marine traffic. Off the southern edge of the Strait of Singapore, at Phillips Channel, the width is the narrowest, measuring just 1.96 nautical miles. In especially in the TSS region, the Straits of Malacca and Singapore allow for cross-strait or coastal shipping. (Mohd Rusli, M. 2011). One of the challenges to safe traffic navigation since 2008 has been noted as the steady increase in coastal shipping. Since the United Nations encourages the development of international organizations relating to transportation safety, international agreements have not yet been able to exempt practically the entire nation from the numerous laws.

The density is linked to a number of issues and frequent maritime accidents, including shipping security. (Akpan F., 2022) It is believed that the government is unable to guarantee the security and safety of marine transport operations, especially how to carry out enforcement at sea. For instance, it is not obvious who has jurisdiction over law enforcement at sea with regard to all shipping-related safety and security issues. (Bueger, C.,2015). In addition, collisions frequently happen

because to the densely populated waters and the presence of ships. For international ships traveling across ocean waters, the shipping channel in the Malaca Strait is recognized as the flow of innocent passage.

Table 2 Characteristics of Sea Transport Accident Analysis

	ACCIDENT TYPE	Object
WHAT	Safety and Accident Type Indicator a. Accident Types: Sink, Burn, Collide, and Drown b. Injury Level	Sailboats and engine ships, vehicle, tugboat, and barge, Tanker
WHY	Potential Accident Cause a. Human Factor • Imprudence in ship operation • The inability of the crew to handle various problem-solving may occur in the operation of the ship. • Careless ship operations b. Technical Factor • Errors in the ship's design • The sailors' inability to handle a variety of potential issues when there is an accident while running the ship • Realizing the ship is loaded to capacity • Ship maintenance inattention that results in burns or fires or damages the ship's components. c. The Natural Factor d. Unfavorable weather, including a storm, a high tide, an overrated current, and fog that reduces visibility.	Captain of the ship, Ship Crews, Port Control Officers, Passengers Ship Owner, Marine Inspector, Ship Staff, Dock Officials, Ship Equipment Supplier, Ship flow, Port Pond, Information from Metereological, Climate, and Geophysics Office.

While ship crews need knowledge, understanding, and professionalism to anticipate the risk of accidents, an accident may occur, such as a fire that causes a portion of the ship to burn. The entire ship caught fire, slammed into another vessel, slammed into a dock, or slammed into other seagoing items. The casualty might be a leak in the boat that causes it to sink, as well as a risk of hypothermia, the incidence of sea pollution, and environmental harm. It could also be sinking, shipwrecked, or capsized temporarily or permanently. To prevent worse pollution, the ship's operations that produce pollution must be addressed. MARPOL 73/78 is the regulation that was in effect during the treatment. It includes a set of regulations for sewage and trash in the water as well as ship safety devices to prevent collisions and other mishaps. IMO conventions define rights and obligations for a flag state and guarantee that ships adhere to global technical management and labor laws.

3.4 The Effects of Oil Spills on Marine Resources and Fish;

a. **The Casualties in Malacca Strait**

Around 17.6 to 33.0 accidents occur year according to the Malacca characteristics. According to Singapore MPA figures, the Strait had roughly 1,200,000 vessels pass through it annually in 2019. Thus, incidents of varying severity involved only 0.005% of vessels. (Weng, J.,2012). Therefore, to date, the Strait can be said to be a safe shipping lane. Lack of reporting has been a primary concern of maritime and port authorities. According to the relevant investigation, the database reporting performance is subpar (62.5%). Most instances are not adequately reported for a variety of reasons. Therefore, it is vitally necessary to implement a systematic, required accident reporting system in order to fully comprehend the Strait's operational status.

Vessel collisions account for more than 50% of the various accident severities, considered the Strait's most typical accident type. In fact, a number of systems have been put in place to reduce the number of vessel collisions. For instance, the Traffic Separation Scheme (TSS) was implemented on May 1, 1981, to ensure safer travel over the Singapore Strait and the Straits of Malacca. (Fadzlon, C. 2014).

The ship must anticipate as traffic volume increases, such as the risk of accidents and Pollution. (Chang, S. E., (2014). Accidents originating from canal restrictions or human mistake, such as failing to accurately situationally analyze changing situations, have resulted in both major and minor events in the Straits. It is essential to approach disaster prevention from a proactive rather than a reactive stance.

The highlight of Several marine collisions in the Malacca Straits: (Triasni, S. 2022)

1. In 2011, MV B Oceania sank after colliding with the Xin Tai Hai 8 nautical miles southwest of the Pulau Pisang route to China. According to reports, both generators on the MV B Oceania failed, resulting in a total loss of power. She began to lose momentum and could not alter her course, causing her to drift to port. The two ships collided because they were unable to avoid hitting the MV B Oceania. Following the vessel's removal for salvage, the P&I Clubs of both vessels filed a pool claim.
2. AZ Fuzhou and NYK Themis At East Keppel Fairway, the "NYK Themis," a containership flying the flag of Panama, collided with the "AZ Fuzhou," a

barge.

3. Zoey and Hammonia Thracium The chemical tanker "Zoey" of Panama and the Singapore-bound containership "Hammonia Thracium" collided in the Singapore Strait off Seabrook Island during the same month.
4. Haljin and Al Gharraf The Q-Flex LNG carrier Al Gharrafa and the boxes-hip Hanjin Italy collided severely and in the public eye late last year between Batam Island and Singapore.

In the Malacca Straits, numerous additional incidents and mishaps had a negative impact on the maritime ecosystem. (Rahman, N. A., 2014). Oil leaks caused by several mishaps and collisions in this area in the past significantly harmed the marine environment and human life. These cases were chosen for this study in order to highlight the severity of collision-related marine pollution. On the other side, the formation of ship and marine-related legislation can be attributed to these types of catastrophic catastrophes and marine pollution. Many countries have passed laws to protect the marine environment against mishaps, disasters, and collisions, including Indonesia. Singapore and Malaysia.

Oil spills as a primary source of Pollution in Malacca Water

Ecosystems are affected by oil spills in both acute (quick, short-term) and chronic (long-term) ways. (Rogowska, J., & Namieśnik, J. (2010). Those plants and animals that come into immediate touch with recently spilled oil are most at risk. Many of the chemicals used in oil spills are hazardous, which means that they can severely harm plankton, fish, and animals that live on the seafloor. (Solo-Gabriele, H. M., 2021)

The effects of an oil spill on biota depend on a number of variables, including: (Rogowska, J., & Namieśnik, J. (2010).

- the oil slick's rate of spread;
- the makeup of the oil;
- place where the leak occurred;
- the accident's date or season (bird migrations);
- the petroleum substance's attributes, toxicity, and stability;
- the variety of species at the oil spill's location;
- environmental sensitivity, such as the presence of marshes, beaches, rocks, or bird habitat nearby; and
- habitat types and numbers.

Three main pathways can lead to long-term effects: trophic interaction cascade, delayed population effects of sublethal doses that may impair health, growth, and reproduction, and chronic persistence of oil, biological exposure, and population effects on species that are closely linked to shallow sediments. Beyond the acute-mortality phase, these channels continue to convey effects. (Peterson et al. 2003).

Seabirds and other mammals may come into touch with oil that is present on the ocean's surface. River otters, beavers, sea otters, polar bears, manatees, seals, sea lions, walruses, whales, porpoises, and dolphins are among the species that are impacted. Mammals' sensitivity to oil spills varies greatly. (EPA, 1999). The marine ecology is significantly impacted by these disasters, especially in terms of oil spills. Oil spills are regularly described in the media as "environmental disasters" having

grave implications for aquatic flora and animal survival. The short-term environmental effects of a big disaster can be disastrous, harming ecosystems and the quality of life of those who live close to the contaminated shoreline. It can be difficult to get a balanced perspective on the impact of the spill and the ensuing recovery due to the normally intense and emotional reaction that follows oil spills. (www.itopf.com)

On the other hand, the complexity and resilience of the marine environment determine its ability to rebound from major disturbances. The definition of recovery and the moment at which an ecosystem may be considered to have recovered are hotly contested, but it is generally agreed that the inherent unpredictability of ecosystems makes a return to pre-spill conditions impossible. Instead, the majority of definitions of recovery focus on reestablishing a plant and animal population that is typical of the environment and is usually healthy in terms of biodiversity and production. Following the sinking of the tanker "Torrey Canyon" off the coast of England in 1967, the cleaning up efforts were ineffectual and served as an example of the restoring principle. On rocky shorelines, the use of harmful cleaning products caused considerable harm. The ecosystem's overall functioning, biodiversity, and productivity were recovered within one to two years, despite the fact that the precise distribution of some species had changed and the consequences of the disturbance could be seen going back more than twenty years. The rocky coast village may have recovered within two years, going by the definition above.

However, the age distribution of the constituent species enables us to see this definition's limitations. The newly recruited plants and animals fell within a restricted age range as opposed to the full range of ages before the event, from juveniles to mature organisms, which led to an initially weaker ecosystem. Recovery normally happens within a few seasonal cycles and for the majority of ecosystems within one to three years, with mangroves being a significant exception, as indicated in Table 3 below (www.itopf.com).

Table 3: Recovery times following oiling that are indicative for different environments.

Habitat	Recovery period
Plankton	Weeks/months
Sand beaches	1 – 2 years
Exposed rocky shores	1 – 3 years
Sheltered rocky shores	1 – 5 years
Saltmarsh	3 – 5 years
Mangroves	10 years and greater

Given the context above, by using statistics on maritime accidents and the marine environment and by examining well-known events that resulted in marine pollution in the Malacca Straits, this study sought to create future estimates. The effects of inci-

dents range from minor injuries to fatalities and from negligible to highly severe environmental and property damage. The Indonesian Ministry of Transport devotes a significant amount of resources to upholding a high standard of safety and protecting people, property, and the environment.

This study suggests that ship-generated pollution is a continuing hazard to the maritime environment. Any accident or risk study's main goal is to give decision-makers reliable information so that they can analyze it and, ideally, make better judgments. The analyses make use of a sizable number of different datasets, the most important of which are marine accident data. There are many different research methodologies available, and researchers constantly wonder when and why to choose a specific technique. (Mullai, Paulsson, 2011). The data sets examined in this study include those related to marine accidents and pollution of the marine environment as a result of accidents.

4 Conclusion

Ships continue to contaminate the maritime environment all over the world, especially in the Malacca Straits, despite the fact that legislation relating to pollution have decreased the frequency of accidents and incidents. Physical forces and human mistake may contribute to shipping pollution in various situations. The fact that ship-generated "environmental disasters" harm ecosystems, jeopardize marine life's survival, destroy habitats, and have a detrimental influence on people's quality of life and livelihoods cannot be changed.

Shipping accidents are becoming increasingly hazardous to the environment, with catastrophic consequences for all stakeholders regarding human lives, the environment, and economic losses. Ship bilge water, ballast water, and the dumping of solid waste into the sea all contribute to maritime pollution and environmental risks, in addition to shipping accidents, collisions, and oil spills. To increase the protection of human life, property, and the environment by reducing accidents, incidents, and collisions, the coastal state established numerous pollution and accident-related regulations.

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