

# THE IMPACT OF SHIPPING ACCIDENTS ON MARINE ENVIRONMENT: A STUDY OF TURKISH SEAS

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## Abstract<sup>1</sup>

Shipping accidents are unexpected events that result in financial loss and properties, damages and either loss of people. Several reasons as human errors, technical failures, natural conditions, shipping factors, route conditions and cargo related factors play role in these accidents. Unfortunately, shipping accidents are inevitable cases of maritime field, in contravention of creative and innovative technologies in shipping sector and execution of precautionary safety rules and regulations.

Main purpose of this paper is to investigate the effects of shipping accidents on marine environment in Turkish Seas. Within this scope firstly, the literature related shipping accidents and marine environment were handled. Then, the statistics of shipping accidents and marine environment in Turkish Seas were analyzed. Finally, future projections were provided in the light of presented matters and current developments.

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**Keywords:** Shipping accidents, marine environment, Turkey

## Introduction

Around 90% of world trading is carried out by the shipping industry. Shipping is considered as a safe, economical, and environmental form of commercial transport. Although increasing cases draws public attention to accidents, the statistics show a slow but steady decline in maritime accidents over the past 10 years. This decade follows the general shipping safety improvement trend that took place over the 20th century. Records showed a rate of loss of 1% a year in 1910; this rate has improved to the figure of about one ship in every 670 in 2010. Shipping is also a highly regulated domain, and regulations have been reinforced in the last two decades. The main principles underlying shipping regulations are harmonized national

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rules based on international conventions and resolutions given by the International Maritime Organization (IMO). Over the last decade, the shipping industry has implemented a number of measures aimed at improving its safety level (such as new regulations or new forms of team training). Despite this evolution, shipping accidents, and particularly collisions, remain a major concern (Chauvin, Lardjane, Morel & Clostermann, 2013, p.26).

Marine accidents adversely affect the human, the marine environment, properties and activities aboard ships and ashore in various forms and degree of extent. The effects of accidents vary from minor injuries to fatalities and from insignificant damage to very severe damage to the environment and property. The cost of accidents, including fatalities and injuries, damage to property and the environment, prevention and mitigating measures, and insurance accounts for a considerable share of transport costs (Mullai & Paulsson, 2011, p.1590).

Any shipping accident, whatever in nature, is every seafarer's nightmare. Should it occur in a confined area, like a channel or a strait where the traffic is heavy, several as well as serious risks are likely to be faced. On the other hand, a major shipping accident becomes even more critical by way of, say, water ingress thus possibly worsening the ship's damage stability if exacerbated by heavy weather or strong current. In some other accidents however the issue becomes more "environmental" due to oil spillage (Akten & Gonencgil, 2002).

Shipping accidents affect marine environment in different ways. Not only accidents and collisions are the reasons of marine pollution, but also human errors as oil spillage, solid waste, oil transferring or bunkering accidentally may cause marine pollution. Therefore, maritime accidents and marine pollution statistics which are related human errors were evaluated in this study. This paper collected and analyzed casualty and marine pollution data from 01.01.2008 to 31.12.2012.

## **Literature Review**

### **Shipping Accidents and Marine Environment**

The terms "marine accident and incident" and "marine casualty" denote undesirable events in connection with ship operations (IMO, 1996). The term "marine incident" is used to denote undesirable marine events, i.e. marine accidents, incidents and near missing events (Weintrit, 2009, p.248). An accident is an undesired event that results in adverse consequences, for example injury, loss of life, economic loss, environmental damage, and damage to or loss of property. Accidents are due to an unexpected combination of conditions or events. Despite of the fact that "accident" and

“incident” terms states different meanings and consequences, the term “accident” is used in this paper (Mullai & Paulsson, 2011).

Yet shipping is the bulk delivery mechanism of international trade, and it plays a massive part in humanity’s collective wellbeing; billions tons of raw materials and finished goods are carried onboard ships between ports and port terminals economically, cleanly and without mishap every day. Ships trade in a high-risk operating environment. In the age of precision navigation and the satellite era, many casualties still occur at sea. Even the available advanced and sophisticated navigation instruments and the enhanced communication technologies have been unable to halt shipping accidents (Akten, 2006, p.271).

There may be several causes for shipping accidents. In broad terms these are listed as below (Akten, 2006, p.272):

- Natural conditions could be natural phenomena such as current, tide and tidal stream, severe wind, reduced visibility (fog, heavy snow and rain), storm seas, darkness etc. affecting the ship or those controlling her.
- Technical failures are shortcomings within the ship, such as corrosion, steering failure, engine failure, or hull failure arising from defective materials or construction, or by the shore-based installations, such as aids to navigation.
- Route conditions may include navigational error like over reliance on inaccurate nautical charts, charts of suspect reliability or based upon old surveys, narrow channels with abrupt and angular windings, allowing for very limited maneuverability and exposed to dense marine traffic, such as the Turkish Straits, anchorage contiguous to traffic separation lanes, confined marine areas with insufficient sea-room as well as navigational hazards such as shoals, reefs, wrecks etc.
- Ship-related factors could be the weakness of a ship, associated with her larger size, hence less maneuvering capability and stability or draught constraints.
- Human errors may include, inter alia, a lack of adequate knowledge and experience, technical inability, bad look-out, not paying proper attention to procedures and rules, carelessness in commanding a ship, misinterpretations of radar information, fatigue and lack of alertness, overworking, tiredness, insufficient rest periods, etc.
- Cargo-related factors mostly include dangerous goods and heavy cargoes; i.e. their hazardous characteristics (oils, chemicals, nuclear substances), the place/compartments they are stowed onboard ships

(on deck or under deck), and degree of diligence that such cargoes need (grain, timber), all of which are related to ships' seaworthiness.

Exploring the root causes of merchant shipping accidents is one of the most focused upon themes within ongoing research aimed towards enhancing maritime safety. Recently, some statistical research has identified human error as the primary factor in the majority of marine accidents. The roles of the human element and human competency have been cited within previous researches. Although innovations in marine technology and automation systems have made contributions to improved safety, the rates of shipping accidents have risen and continued to affect marine environment negatively. Moreover, the feedback from maritime accident investigation reports shows enormous challenges to preventing shipping accidents. However, the lack of an effective response to lessons learned from marine accident reports has threatened precautions already taken towards system safety (Celik & Cebi, 2009, p.66).

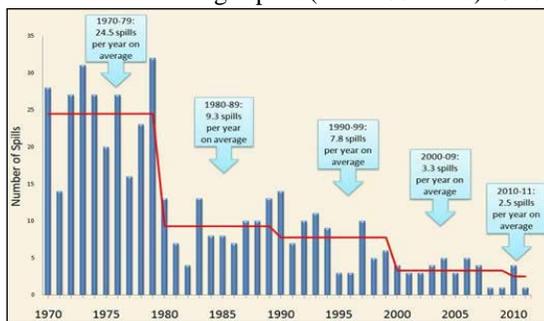
Over one million metric tons of petroleum enters the marine environment annually from municipal and industrial sources, marine transport, natural oil seeps and accidental oil spills. Although the number of the latter has decreased significantly during the past decades, catastrophic accidents such as the sinking of the Prestige tanker near the coast of Galicia (Spain) and the Deepwater Horizon (DWH) platform blowout in the Gulf of Mexico, still pose an important threat to marine and coastal ecosystems, causing extensive environmental and economic damages. While the past history has been promising, new environmental concerns arise as the oil industry is venturing to recover oil into more hostile, challenging and dangerous regions such as ultra-deep-water, Arctic and along national boundaries that lack the infrastructure to respond effectively to any mishaps (Radovic, Aeppli, Nelson, Jimenez, Reddy, Bayona & Albaigés, 2014).

When we consider ship related marine environment cases, there are many ways of ship generated pollution types according to IMO's 2012 Report named International Shipping Facts and Figures Information Resources on Trade, Safety, Security, Environment. Measures introduced by IMO have helped ensure that the majority of oil tankers are safely built and operated and are constructed to reduce the amount of oil spilled in the event of an accident. Operational pollution, e.g. from routine tank cleaning operations, has also been cut. Despite the rare major accident, which can cause a spike in the annual statistics, the overall trend demonstrates a continuing improvement, both in the number of oil spills and quantity of oil spilled each year. The biggest single decade-to-decade reduction in oil spills was from the 1970s to the 1980s, coinciding with the adoption and entry into force of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto MARPOL

73/78 which is rightly credited with having had a substantial positive impact in decreasing the amount of oil that enters the sea from maritime transportation activities. The International Convention for the Safety of Life at Sea (SOLAS), 1974 also includes special requirements for tankers. The amount of oil spilt at sea today bears no comparison with the levels of twenty or even ten years ago, accidents involving tankers causing serious pollution still happen from time to time. There is also concern about continuing instances of deliberate non-compliance, whereby a small minority of ship officers flout company procedures and MARPOL pollution prevention rules, despite the million-dollar fines being imposed on parties found guilty of such malpractices (IMO, 2012).

When we investigate the number of spills and quantity of oil spill, statistics show that 50% of large spills occurred while the vessel was underway in open water, collision groundings accounting for just over half of these. These same causes accounted for some 95 incidents when the vessel was underway in inland or restricted waters. Figure 1 shows the numbers of large spills (over 700 tonnes) from 1970 to 2011.

Figure 1. Numbers of large spills (over 700 tonnes) 1970-2011



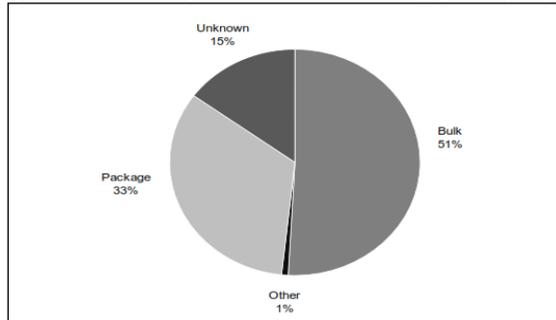
Source. IMO (2012)

The number of large spills (>700 tonnes) has decreased significantly during the last 42 years. The average number of major spills for the previous decade (2000-2009) is just over three, approximately eight times less than for the 1970s. Looking at this downward trend from another perspective, 55% of the large spills recorded occurred in the 1970s, and this percentage has decreased each decade to 7% in the 2000s. Most spills from tankers result from routine operations such as loading, discharging and bunkering which normally occur in ports or at oil terminals; the majority of these operational spills are small, with some 91% involving quantities of less than 7 tonnes; accidental causes such as collisions and groundings generally give rise to much larger spills, with at least 84% of incidents involving quantities in excess of 700 tonnes being attributed to such factors (IMO, 2012).

Hazardous and noxious substances (HNS) spill is another pollution threat for marine environment. The wrecking of the chemical tanker the

Ievoli Sun in the Channel in 2000 highlighted the danger involved in chemical tanker accidents. From 14 June 2007, ships flying the flag of a Party to the OPRCHNS Protocol (Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances) must carry a pollution emergency plan to deal specifically with incidents involving hazardous and noxious substances, such as chemicals. The Protocol defines HNS as substances other than oil, which, if introduced into the marine environment, have the potential to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea (IMO, 2012). Figure 2 displays the percentage of HNS incidents by package type.

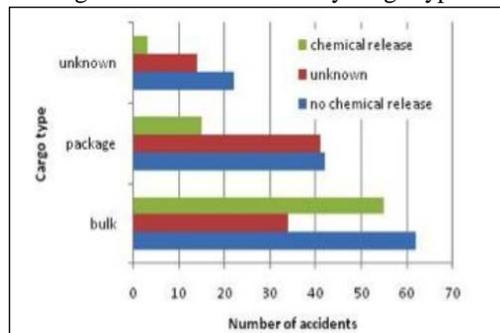
Figure 2. Percentage of HNS incidents by package type



Source. IMO (2012).

Examination of the data for the period from January 2006 to June 2011 indicates that of the 235 incidents involving 247 HNS products that cause or have the potential to cause pollution, 123 of these involved products in bulk. An additional 82 involved products in packaged form, while 40 could not be determined due to insufficient data. The International Spill Control Organization (ISCO) has analyzed 291 HNS accidents that have occurred in the past. Of these, 25% led to an actual chemical release and 16% led to loss of packaged goods (IMO, 2012). Figure 3 shows the results of the incidents by cargo type.

Figure 3. HNS incidents by cargo type



Source. IMO (2012).

As can be seen from Figure 3, most of the reported cases involve ships carrying bulk goods (52%) in terms of HNS accidents. This figure reveals the importance of HNS accidents in terms of cargo types.

The impact of these accidents on marine environment is significant especially in terms of oil spill. Oil spills can cause a wide range of impacts in the marine environment and are often portrayed by the media as “environmental disasters” with dire consequences predicted for the survival of marine flora and fauna. In a major incident the short-term environmental impact can be severe, causing serious distress to ecosystems and to the people living near the contaminated coastline, affecting their livelihoods and impairing their quality of life. Given the highly charged and emotional reaction usually associated with oil spills, it can be difficult to obtain a balanced view of the realities of spill effects and subsequent recovery ([www.itopf.com](http://www.itopf.com)).

A scientific appraisal of typical oil spill effects reveals that, while damage occurs and can be profound at the level of individual organisms, populations are more resilient. In time, natural recovery processes are capable of repairing damage and returning the system to its normal functions. Long term damage has been recorded in a few instances. However, in most cases, even after the largest oil spills, the affected habitats and associated marine life can be expected to have broadly recovered within a few seasons. Oil may impact an environment by one or more of the following mechanisms ([www.itopf.com](http://www.itopf.com)):

- Physical smothering with an impact on physiological functions;
- Chemical toxicity giving rise to lethal or sub-lethal effects or causing impairment of cellular functions;
- Ecological changes, primarily the loss of key organisms from a community and the takeover of habitats by opportunistic species;
- Indirect effects, such as the loss of habitat or shelter and the consequent elimination of ecologically important species.

The nature and duration of the effects of an oil spill depend on a wide range of factors. These include: the quantity and type of oil spilt; its behavior in the marine environment; the location of the spill in terms of ambient conditions and physical characteristics; and the timing, especially in relation to the season and prevalent weather conditions. Other key factors are the biological composition of the affected environment, the ecological importance of the component species and their sensitivity to oil pollution. The selection of appropriate clean-up techniques and the effectiveness with which operations are conducted can also have a significant bearing on the effects of a spill ([www.itopf.com](http://www.itopf.com)).

On the other hand, the ability of the marine environment to recover from severe perturbations is a function of its complexity and resilience.

While considerable debate exists over the definition of recovery and the point at which an ecosystem can be said to have recovered, there is broad acceptance that natural variability in ecosystems makes a return to the exact pre-spill conditions unlikely. Most definitions of recovery instead focus on the re-establishment of a community of flora and fauna that is characteristic of the habitat and functioning normally in terms of biodiversity and productivity. This principle can be illustrated by the experience of inappropriate clean-up operations following the loss of the tanker “Torrey Canyon” off the coast of England in 1967, in which the use of toxic cleaning agents on rocky shorelines led to considerable damage. Although the detailed distribution of particular species present was altered and the effects of the perturbation could be traced over more than two decades, the overall functioning, biodiversity and productivity of the ecosystem was re-established within one to two years. Under the definition proposed above, the rocky shore community could be said to have recovered within the two year period. Nevertheless, the limitations of this definition can be recognized by considering the age distribution of the component organisms. Instead of the full range of ages prior to the incident, from juveniles to mature organisms, the newly recruited plants and animals fell within a narrow age range and consequently the community was, initially, less robust. In most cases recovery typically takes place within a few seasonal cycles and for most habitats within one to three years, mangroves being a notable exception, as shown in Table 1, below ([www.itopf.com](http://www.itopf.com)).

Table 1: Indicative recovery periods after oiling, for various habitats.

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

Source: [www.itopf.com](http://www.itopf.com)

Given the above context, the purpose of this study was to develop future projections by using shipping accident and marine environment statistics while analyzing well known accidents which resulted in marine pollution in Turkish Seas.

### **Shipping Accidents and Marine Environment Statistics of Turkish Seas**

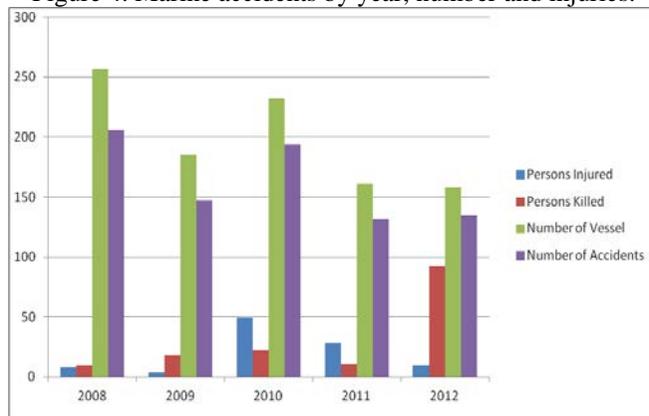
The maritime transport system is vital for Turkish economy. Marine accidents adversely affect the human, the marine environment, and

properties and activities aboard ships and ashore in various forms and degree of extent. The effects of accidents vary from minor injuries to fatalities and from insignificant damage to very severe damage to the environment and property. Turkish Ministry of Transport, Maritime Affairs and Communications spends considerable amounts of resources in order to maintain a high level of safety and protect property and the environment.

The main purpose of every accident or risk study is to provide decision makers with valid and reliable information in order to make informed and hopefully better decisions. The analyses make use of large amounts of diverse datasets, the most important of which are marine accident data. There is a wide range of research strategies available, and researchers are often confronted with the questions of when and why to use a particular research strategy. (Mullai, Paulsson, 2011). This study relies on data sets as marine accidents and accident related pollution of marine environment.

As in many other countries, marine accident data are recorded in a database in Turkey and this is officiated by Turkish Ministry of Transport, Maritime Affairs and Communications. According to Ministry’s reports, Figure 4 shows number of maritime accidents and incidents, number of vessel involved in maritime accidents and incidents, persons killed and persons injured by the year from 2008 to 2012. These statistics includes both Turkish flagged and foreign flagged vessels. 206 accidents occurred in Turkish Seas in 2008. The following years show the number of accidents as; 206 in 2008, 147 in 2009, 194 in 2010, 132 in 2011 and 135 in 2012.

Figure 4. Marine accidents by year, number and injuries.



Source. Ministry of Transport, Maritime Affairs and Communications

As it can be seen from Figure 4 the number of vessel which involved in maritime accidents is decreased from 2008 to 2012. The reasons of this decline can be technological developments, implementation of strict regulations and high level penalties.

Particularly, current maritime regulations have been developed very reactive approaches to the accidents. These regulatory improvements have been imposed to prevent recurrence of specific type of accidents or incidents. In spite of taking criminal action against the accidents, the collision, incidents and accidents are still a major concern of maritime field not only in all the seas in the world but also in Turkish Seas.

When we investigate these accidents in terms of marine pollution for Turkish Seas, following accidents have been recorded which cause pollution from 2008 to 2011. M/V Vector was sunk in Black Sea on 25.10.2009 and solid waste and oil spillage caused marine pollution. M/Y Liberti was sunk after fire and 500 hundred liter diesel oil was leaked to Aegean Sea on 22.10.2009. 30 cubic meters JET A 1 (aircraft fuel) was leaked into the sea by M/T Breeze A in Marmara Sea on 01.10.2009. M/Y Marinel 1 was sunk on 30.09.2010 and caused marine pollution. M/V Orcun went aground in Marmara Sea on 19.01.2010 and caused pollution. M/V Zorbey went aground on 03.11.2011 and caused pollution in Mediterranean Sea. M/V Amstelborg crashed to jetty and 30 tones fuel oil was leaked into Marmara Sea.

From the historical perspective, there were serious disasters that resulted in major marine pollution in Bosphorous as World Harmony, Independenta, Unirea, Nassia, TPAO and Volganefit ([www.cygm.gov.tr](http://www.cygm.gov.tr)). Most of these accidents have occurred in Bosphorous Sea and their damages and diseconomies to marine environment are immeasurable. Yugoslavian flagged M/T *Petar Zoranić*, carrying gasoline, collided with the Greek tanker M/T *World Harmony* at Kanlıca Point on 14 December 1960. 20 ships officers and crew died, both masters included. 18,000 tons of oil spilled and caused pollution. Fire lasted for some weeks and suspended transit traffic. M/T *Independenta* was a large Romanian crude oil tanker. She collided in 1979 with a Greek ship at the southern entrance of Bosphorous and exploded. She caught fire and grounded. Almost all of the tanker crew members died. From 17 to 27 November there was slight leakage from the tanker. It was estimated that 30.000 tons of crude oil burned and remained 64.000 tons spilled into the sea. The spilled crude oil sank rapidly to the bottom. An area of the sea bottom approximately 5.5 km in diameter was covered with a thick tar coat of a mean concentration of 46 g/m. In this area, only nine species of benthos were recorded alive, and the mortality rate was estimated at 96% (Doğan & Burak, 2007, p.389).

The huge dimensions of marine vessels and subsequent increase in the amount of cargo have introduced new approaches to avert pollution risk from maritime accidents. The most unfortunate example was the collision and sinking of a Lebanon flag vessel Rab Union-18 carrying live sheep near Fatih Bridge in 1991. This vessel sank with 20,000 sheep and its own oil at

32 meters depth, and it has not yet been hauled up onto shore. The sinking of M/S Rab Union-18, after collision with Madonna Lily, carrying so many sheep, has created great anxiety in the public opinion. It was claimed that decay of the bodies of the animals would cause a high degree of pollution in this important waterway (Doğan & Burak, 2007, p.391).

M/T Nassia collided with the bulk carrier M/V Shipbroker on 13 March 1994. 27 people lost their lives and 9.000 tons of petroleum spilled and 20.000 tons burnt four days long affecting marine environment severely. Traffic in the Strait was suspended for several days and Shipbroker burnt totally. After this accident dispersed 20,000 tons of oil to the sea, the marine ecosystem has been destroyed, and all bays and beaches around have been covered with oil and pitch. Major concerns are related to potential effects of spilled oil on commercial. Fisheries and aqua-culture products and to the loss and/or change of habitats. Chronic long-term accumulation of hydrocarbons in coastal and estuarine waters and their contribution to a gradual change of ecological systems has been an issue given the fact that oil products are significantly toxic and adversely influence the life activity of the benthos. Total polyaromatic hydrocarbon concentration has decreased gradually in seawater, but it increased in sediments after the accident (Doğan & Burak, 2007, p.391).

TPAO Tanker burned in Tuzla Bay on 13 December 1997 1500 tons petroleum spilled into the sea. During the week following the TPAO tanker accident, the sampling required to investigate the impact of oil spill pollution on the marine life could not be carried out in the inner part of the bay because of heavy oil slicks. Especially following the TPAO accident, very high mortality of fish eggs and/or larvae showed the effect of oil and metal pollution in the bay on the biota. The oil pollution level decreased to the normal level as given in the literature nearly 7 months after the accident (Doğan & Burak, 2007, p.392).

M/T Volganefit-248 grounded at Florya with 4.000 tons of fuel oil on board and split into two pieces on 29 December 1999, 1500 tons of oil spilled into the sea. Clean-up operation of the contaminated recreational beaches took about two years ([www.seanews.com.tr](http://www.seanews.com.tr), [www.cygm.gov.tr](http://www.cygm.gov.tr), [www.authorstream.com](http://www.authorstream.com), [www.tudav.org](http://www.tudav.org)). Ecological damage from this accident was computed as 90% of total mortality of sea life. Most of the migrating fish were not affected directly, but plankton and small organisms, more sensitive to oil pollution, were. The worst environmental pollution in that case happened at the sea surface, sea floor, within the water column, and along the coast. Within a time span of several hours after the accident, the spilled oil was washed on the shores and contaminated the area between the grounded ship stern off the Florya coast. The sandy beaches, rocks, concrete promenades, fishing ports, and coastal structures located along the shoreline

were and continue to be directly affected. It is well known that the petroleum residues from tanker operations, accidents, and other maritime sources continue to contaminate many coastlines and beaches worldwide (Doğan & Burak, 2007, p.392).

There were numerous more accidents and collisions that affected marine environment negatively in Turkey. There were numerous more accidents and collisions resulting in oil spills occurred in the past within this region where damage marine environment and human life substantially. These examples were selected in this study only to shed some light on magnitude of collision related marine pollution.

On the other hand, these kinds of catastrophic accidents and marine pollution have constituted the emerging of ship and marine related regulations. To protect marine environment from accidents, incidents and collisions, many nations worldwide have enacted legislation and also Turkey. To illustrate this, Turkey is a party of some protocols, agreements and conventions related with accidents and pollution. Some of them are listed in Table 1.

Table 1: Marine Pollution Agreements That Signed by Turkey

<b>MARINE POLLUTION AGREEMENTS OF TURKEY</b>	<b>DATE OF ENTRY INTO FORCE</b>	<b>DATE OF TURKEY SIGNED</b>
Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and Their Disposal	1994	1994
Stockholm Convention on Persistent Organic Pollutants	2004	2010
United Nations Framework Convention on Climate Change, UNFCCC	1994	2004
The Vienna Convention for the Protection of the Ozone Layer	1985	1991
Convention on Long-Range Transboundary Air Pollution	1982	1983
Convention for the Protection of the Mediterranean Sea Against Pollution (Barcelona Convention)	1976	1976
Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention)		1994
The International Oil Pollution Compensation Fund 1992	2002	2002
Civil Liability Conventions 1992	2002	2001
The International Convention for the Prevention of Pollution from Ships (MARPOL)		1980
Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal	1996	2003
The Montreal Protocol on Substances that Deplete the Ozone Layer	1987	1991
The Kyoto Protocol	2005	2009
Protocol Concerning Cooperation in Preventing Pollution from Ships and, in Cases of Emergency, Combating Pollution of the Mediterranean Sea		2004
Protocol for the Prevention and Elimination of Pollution in the Mediterranean Sea by Dumping from Ships and Aircraft or Incineration at Sea	1977	1981
The Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea Against Pollution		2004
Protocol on The Protection of The Black Sea Marine Environment Against Pollution by Dumping		1994
Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources	1999	2002

Source: <http://www.csb.gov.tr>

## **Conclusion**

Nowadays, shipping accidents have become more and more environmental and the results of them crucial for all parties in terms of human lives, marine environment, trading and financial losses. Not only shipping accidents, collisions and oil spills harm the marine environment, but also ship's bilge water, ballast water, and discharging solid waste into the sea cause environmental hazards and create irrevocable marine pollution. Therefore many regulations related to pollution and accidents are constituted to enhance safety of human life, property and preserve the environment by alleviation of accidents, incidents and collisions.

As indicated in this study IMO (2012) reports reveal that marine environment is still under the threat of ship generated pollution. Although the pollution related regulations decreased the number of accidents and incidents, marine environment is still being polluted by ships around the world and also in Turkish Seas. Some of the cases are outcome of human error and some of them are outcome of physical factors. Whatever it happens, people cannot change the fact that ship generated "environmental disasters" damage habitat and marine life, harm survival of marine flora and fauna, cause serious distress to ecosystems and affect people's livelihoods and impair the quality of life.

With reference to this research, some solutions are suggested in order to tackle some of the marine environmental problems for Turkey. Improved standards for ships, management and seafarers should be more taken into account. Implementation and strict control of regulations to avoid accidents will make major impact on reducing pollution. Government should enhance cooperation among maritime authorities and other parties. To illustrate, the authority convergence between Turkish Ministry of Transport, Maritime Affairs and Communications and Ministry of Environment and Urban Planning should be solved and they should be in cooperation. The shipping companies and seafarers should raise awareness of maritime risks and the aftermath of the accidents and especially oil spill related pollution. National policies and strategies should be developed to prevent pollution.

Other than these precautions Turkey should fulfill the need for being party of some international conventions such as Annex III (Prevention of pollution by harmful substances in packaged form), Annex IV (Prevention of pollution by sewage from ships) and Annex VI (Prevention of air pollution from ships) of MARPOL. Within this framework, quality of oil consumption should be improved, the number of waste receiving facilities should be enhanced and new technical developments related with nautical equipment should be followed strictly. Lastly Turkey should adapt the national legislation according to current affairs.

Finally main objective should be avoiding marine pollution rather than punishment of pollution related activities and the pollution penalties should be disincentive. Owing to the fact that even an ultra high penalty cannot bring back a polluted marine environment, prevention is better than the cure.

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- <http://www.csb.gov.tr/gm/cygm/index.php?Sayfa=sayfa&Tur=webmenu&Id=265> <20.03.2014>