

**DOKUZ EYLUL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED
SCIENCES**

**ASSESSMENT OF THE ENVIRONMENTAL RISK
ASSOCIATED WITH THE PETROLEUM
TRANSPORT THROUGH
THE TURKISH STRAITS SYSTEM**

**by
Şebnem Doğa ATAY**

**August, 2006
İZMİR**

**ASSESSMENT OF THE ENVIRONMENTAL RISK
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THE TURKISH STRAITS SYSTEM**

**A Thesis Submitted to the
Graduate School of Natural and Applied Sciences of Dokuz Eylül University
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Environmental Engineering, Environmental Science Program**

**by
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M.Sc. THESIS EXAMINATION RESULT FORM

We have read the thesis entitled "**ASSESSMENT OF THE ENVIRONMENTAL RISK ASSOCIATED WITH THE PETROLEUM TRANSPORT THROUGH THE TURKISH STRAITS SYSTEM**" completed by **ŞEBNEM DOĞA ATAY** under supervision of **Prof. Dr. ORHAN USLU** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Doctor of Philosophy.

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ASSESSMENT OF THE ENVIRONMENTAL RISK ASSOCIATED WITH THE PETROLEUM TRANSPORT THROUGH THE TURKISH STRAITS SYSTEM

ABSTRACT

The Turkish Straits and the Marmara Sea, which has been a “mistress” for all countries and has undertaken the role of economical and ecological passage, augments the geostrategical importance of Turkey within the international system.

Recently, increase in shipping and oil transportation through the Straits, also led to the emerging new risks within the region. The number of tankers at the edge of the Straits of İstanbul and Çanakkale exceeds over the acceptable limits. Zeroizing risks in the Straits is not possible, as it constitutes main route for shipping. The point is that, the risks should be managed through legal regulations and *ad-hoc* measures.

Regarding recent collisions in the Straits and their ecological results, minimizing or overcoming the negative effects of oil spills is vitally important in order to protect wild life in the Marmara Sea. Knowing the biological variety, would play an important role in executing scientific researches, which will make it possible to see the differences in current situation and explain the speciality of the Straits to the world.

As pollution increases day by day, and as a result affects all countries and all livings through flows, countries are seeking for common agreements that would control the environmental effects. Oil spills are investigated meticulously since they leave permanent effects in sea ecology as well as in the air and on land.

This research aims to explain, historical, geostrategical and economical perspectives of the Turkish Straits, the characteristics of the Turkish Straits System and the Black Sea, tanker collisions and their affects, national and international legal

framework of the issue, risk analysis, researches conducted by Turkey and recent developments in the region.

Keywords: Turkish Straits System, Strait of Istanbul, Strait of Canakkale, Oil Spill, Risk Assessment

TÜRK BOĞAZLAR SİSTEMİ'NDE PETROL TAŞIMACILIĞINDAN KAYNAKLANAN RİSKLERİN DEĞERLENDİRMESİ

ÖZ

Tarihin eski çağlarından beri tüm devletlerin gözdesi olan, özellikleri itibari ile ekolojik ve ekonomik bir koridor görevini üstlenmiş olan Türk Boğazları ve Marmara Denizi, kendine has özellikleri ile Türkiye'nin stratejik ve siyasi önemini de arttırmaktadır.

Son yıllarda artan deniz trafiği ve petrol taşımacılığı ile birlikte Boğazlar Bölgesi'ndeki riskler de artmış, İstanbul Boğazı kuzey girişinde; gerekse Çanakkale Boğazı kuzey girişinde (Şarköy önleri) biriken gemilerin ve özellikle tankerlerin oluşturduğu risk kabul edilebilirlik sınırlarını aşmıştır. Deniz ticareti için yoğun bir şekilde kullanılan Türk Boğazları'nda riskin sıfırlanması mümkün değildir. Önemli olan, hukuki düzenlemeler ve alınan özel önlemler ile bu riskin yönetilmesinin sağlanmasıdır.

Boğazlar'da geçmiş yıllarda meydana gelen kazalar ve bu kazaların ekolojik açıdan belirlenebilmiş zararları gözönüne alındığında, petrol dökülmelerinden kaynaklanacak olumsuz etkilerin minimize edilebilmesi ya da ortadan kaldırılabilmesinin, Marmara Denizi ve diğer denizlerdeki canlı çeşitliliğinin korunması açısından önemi büyüktür. Biyolojik çeşitliliğin bilinmesi, yapılacak bilimsel çalışmalar ve izlemeler ile mevcut durumdaki değişikliklerin görülmesi önlemlerin alınması ve Boğazlar'ın özel durumunun dünyaya anlatılması açısından önemli destek sağlayacaktır.

Çevresel kirliliğin her geçen gün artması ve sadece meydana geldiği alanı değil taşınımlarla bütün ülkeleri, biyolojik döngü ile de tüm canlıları etkilemesi nedeni ile ülkeler tarafından, ortak anlaşmalar yapılarak çevresel etkilerin kontrol altına alınmasına çalışılmaktadır. Havada, karada yarattığı olumsuz etkilerin yanısıra deniz

ortamında neden olduđu kalıcı etkiler nedeni ile tanker kazalarından kaynaklanan petrol kirliliđi ve petrol sađılmalarının hassasiyetle üstünde durulmaktadır.

Bu çalışmada, Türk Boğazları'nın tarihteki durumu, stratejik, ekolojik ve ekonomik önemi, Türk Boğazlar Sistemi'nin ve Karadeniz'in özellikleri, meydana gelen tanker kazaları ve etkileri, konu ile ilgili ulusal ve uluslararası mevzuat, risk deđerlendirmesi ve örnek çalışma ile Türkiye tarafından yapılan çalışmalar ve son gelişmeler hakkında bilgi verilmektedir.

Anahtar Sözcükler: Türk Boğazlar Sistemi, İstanbul Boğazı, Çanakkale Boğazı, Petrol Döküntüsü, Risk Deđerlendirmesi

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CHAPTER ONE

INTRODUCTION

The Strait of Istanbul, which has been one of the most significant waterways of the world, constitutes special importance with its geography and unique beauty throughout the world. Mythologically, the Strait of Istanbul was said to be formed, when beautiful Europa and handsome Asia, whose hands were just to reach each other, transformed into rock because of the Giants, chasing them in order to separate the lovers; thus the cavities were filled with the tears of two mythological characters (Figure 1.1). The Strait of Istanbul, having remarkable significance in the world history, brings the Black Sea together with the Mediterranean Sea through Marmara Sea and the Strait of Çanakkale.



Figure 1.1 : The Sand sculpture of formation of Istanbul Strait in mythology, Sandcity, Lara Antalya 2006

The city of Istanbul, having a 3000-year history, not only has historically been the center of many civilizations, among which Byzantium and Ottoman Empires take place; but also has been named as the Common Inheritance of Humanity by UNESCO, since its ecology accommodates 33 endangered sea creatures. The city has also been among the “100 Historical Sites Having Common Importance” with respect to the historical and cultural characteristics.

The Turkish Straits are the only waterways, which have no other alternative routes. 164-mile waterway which includes the Strait of Çanakkale, the Marmara Sea and the Strait of Istanbul, is called as the Turkish Straits System. As it is well-known, the Turkish Straits are international open waterways allowing international shipping, in accordance with the 1936 Montreux Convention, which constitutes the legal framework of the Turkish Straits System.

Türkiye is to develop many projects regarding issues of energy, as she is located between the countries of Caspian Basin, Central Asia and the Middle East, which are rich in hydrocarbon, and European countries, which make up a great market. Oil transportation through navigation, has reached a critical level, due to the geographical, ecological and socioeconomical characteristics of the Turkish Straits. In 2005, 150 million tons of crude oil was transported via the Turkish Straits, and the amount has been increasing year after year. This natural waterway, which is vitally important for Black Sea countries in terms of foreign trade, should no longer be used as a “pipe-line”. One gorgeous accident, may lead to an environmental disaster and navigation through this waterway may be stopped for a long time.

Recently, increase in shipping and oil transportation through the Straits, also led to the emerging new risks within the region. The number of tankers at the edge of the Straits of Istanbul and Çanakkale exceeds over the acceptable limits. Zeroizing risks in the Straits is not possible, as it constitutes main route for shipping. The point is that, the risks should be managed through legal regulations and *ad-hoc* measures.

Regarding recent collisions in the Straits and their ecological results, minimizing or overcoming the negative effects of oil spills is vitally important in order to protect wild life in the Marmara Sea. Knowing the biological variety, would play an important role in executing scientific researches, which will make it possible to see the differences in current situation and explain the speciality of the Straits to the world.

As pollution increases day by day, and as a result affects all countries and all livings through flows, countries are seeking for common agreements that would control the environmental effects. Oil spills are investigated meticulously since they leave permanent effects in sea ecology as well as in the air and on land.

Oil, which is a primary energy source in current world, is a general term that describes a wide variety of natural substances of plant, animal or mineral origin, as well as a range of synthetic compounds. Crude oil is a naturally formed substance, generated by geological and geochemical processes. A variety of petroleum products are then derived from this natural resource. Since their compositions vary, each type of crude oil and petroleum product has unique characteristics or properties. These properties influence how petroleum would react when it is released, and determine its effects on biota and habitats.

This research aims to explain, historical, geostrategical and economical perspectives of the Turkish Straits, the characteristics of the Turkish Straits System and the Black Sea, tanker collisions and their affects, national and international legal framework of the issue, risk analysis, researches conducted by Turkiye and recent developments in the region.

CHAPTER TWO

THE HISTORY AND RECENT DEVELOPMENTS REGARDING TURKISH STRAITS

2.1 The History of Straits

Seas are joint property of mankind. Navigation and passage is free. The freedom of navigation and passage has been formulated with “mare liberum” principle “Mare liberum is the principle stating that vessels navigating in sea should enjoy the freedom of navigation regardless of the jurisdiction on territorial waters. In line with this principle commercial vessels shall have the right to navigate freely “non-stop or directly” but on condition that it should be innocent passage, day and night without permission in worlds seas. Non-stop navigation only can be stopped only due to force majeure such as vessel breakdown, sea accident”.

Mare liberum principle which has been put forward by a Dutchman Hugo Grotius in 16th century and required a long time to become universal through contentions, has evolved in time and substituted by “freedom of seas” rule. Indeed navigation freedom is a form of implementation of “freedom of seas” (Arslan, 2005)

Straits have always been on agenda as a global issue with regard to economical, military and political aspects and have attracted the intension of all countries, primarily Russia. Being an important maritime trade route connecting Europe and Asia continents, the straits was taken by Turkish sovereignty in 1453 and remained under unconditional jurisdiction of Ottoman Empire until 1841. It is possible to divide the historical past of region which has always been in agenda as The Issue of Straits into periods.

2.1.1 1453-1774 Period:

In this period, the Turkish domination on Straits is absolute. Passage from straits was subject to the principles that Empire dictates. The rights for free passage from straits and trade in Turkish ports have been given to vessels carrying British, French and Dutch flags. Although Russians have reached Sea of Azov following the capture of Azov Fortress, they didn't have the right to establish military and trade fleet in Black Sea and Sea of Azov as a result of treaty signed in 1739 (TPAO Archive, 1996).

2.1.2 1774-1841 Period:

Although the dominance of Ottoman Empire on straits still continues at least legally in this period some states have acquired free passage right from straits. During the period in which Ottoman Empire dominated Black Sea, Marmara Sea and Straits there were no issue related to straits. "However when Russia rules the northern shores of Black Sea, Ottoman Empire recognized the free passage right of Russian trade vessels" (TPAO Archive, 1996). Thus the characteristics of Black Sea as a Turkish lake for almost 300 years has come to end. By Ottoman-Russia Treaties dated 1798 and 1805 Black Sea has been closed for all warships from other states. Free passage from straits was granted for Russian warships and it was agreed also that in the event in which foreign warships forcing the straits Ottoman-Russian fleet would resist together. But this treaty ceased to be effective soon after signature because of Ottoman-Russia war in 1807 (<http://www.dallog.com/kavramlar/bogazlarmes.htm>, 2004).

Ottoman Empire has undertaken to keep Straits closed for foreign warships with Kala-i Sultaniye (Çanakkale) Treaty signed in January 5th 1809. Russia has acquired the right of passage from straits for commercial vessels by Edirne Treaty in 1829. Ottoman Empire also opened the Straits for commercial vessels of all states which is

not in war with her. Sultan Mahmut II has assented to close the Straits in favor of Russia for foreign warships by signing Hünkâr İskelesi Treaty in 1833 in return for support given for Egypt problem. This agreement was superseded by London Treaty for Straits in July 15th 1841, by which it was adopted as a rule that the straits shall be closed for any warship other than Ottoman warships in peace time. Notwithstanding this rule, Britain and France which were alliances of Ottoman Empire during Crimea War passed their fleets from Straits to attack Russia (<http://www.dallog.com/kavramlar/bogazlarmes.htm>, 2004).

2.1.3 1841 Agreement and Afterwards:

This period can be named as the period in which Straits were subjected to an international regime. London Treaty on Straits has been effective until Lausanne Treaty on Straits in July 24th 1923, by which all warships were granted with free passage from Straits. After Mondros Armistice signed October 30th 1918 following the end of First World War the control of Straits was actually taken from Ottoman State and given to Allies. Only Ottoman Empire, Austria, France, Britain, Russia and Prussia participated to London Conference in 1841 and only the issue of Straits was discussed. According to Treaty the passage from Straits was taken out of the jurisdiction of Ottoman Empire or provisions of agreements signed by Ottoman Empire and various states and an international regime was established. After this period which lasts until 1856 Paris Treaty, the aims of Russia on Black Sea were significantly blocked. However Russia notified that she didn't accept herself bounded by the provisions of agreement related to Black Sea and made the treaty void unilaterally. Thereupon London Conference was held on March 13th 1871 and free passage was granted for commercial vessels from straits, bilateral agreements between Ottoman Empire and Russia were revoked and the provision stating that Padişah may open the Straits for friendly and allied warships in peace time was accepted although it was agreed that the straits should be kept closed for warships (TPAO Archive, 1996).

In Berlin Conference in 1878 no resolution was made changing the Regime of Straits and this situation continued until Sevres Treaty signed in 1920 following the end of First World War started in 1914. With this treaty it was allowed free for any vessel to pass from straits and provisions stating that if the rights of minorities living in Istanbul are not protected by Padişah the situation of Istanbul may be reviewed were agreed. Additionally an “International Commission” was established for administration of new regime in Straits. The Issue of Straits was discussed again in Lausanne Treaty signed in 1923 following the Independence War (TPAO Archive, 1996).

As a result of Lausanne Convention on Straits signed coincidentally with Lausanne Treaty, the straits were demilitarized and the passage of warships was allowed free from any permission. During peace time free passage was granted for foreign commercial vessels. If Türkiye stays impartial, principles valid for peace time were accepted to be valid also in any war time. In case of a war in which Türkiye is a party, vessels of impartial states may freely use straits providing that they don't help to enemy.

Türkiye claimed first time in London Disarmament Conference in 1933 a modification of London Convention on Straits for the status of Straits regime, since it includes provisions constrains her sovereignty. By Montreux Conference which was attended by states party to London Convention on Straits except Italy, Montreux Convention which authorized Türkiye for fortification of Straits and restricts passage of warships that belong to states which has not shore on Black Sea was signed in July 20th 1936 (<http://www.dallog.com/kavramlar/bogazlarmes.htm>, 2004).

2.1.4 Montreux Convention

The valid jurisprudence which regulates navigation freedom in Turkish Straits is Montreux Convention. Signed in July 20th 1936 and named as the place where it signed, this treaty; was ratified by Australia, Bulgaria, Great Britain, France, Japan,

Romania, Soviet Union, Yugoslavia, Greece and Türkiye and entered into force at the date of signature (<http://www.denizhaber.com>, March 22, 2005).

By this treaty the security of Türkiye, the security of Black Sea, freedom of passage, maintenance of Black Sea-Mediterranean balance was adopted as basic principles. Montreux Convention states that; in peace time commercial vessels may pass straits freely whether it be day or night regardless of its flag and load, the vessels of states which are in war should not pass through straits, International Commission on Straits shall be revoked, straits shall be free of soldiers and if Türkiye enters into war the decision about passage of warships from straits shall be given by Turkish Government. According to the treaty, the number of warships of states which has no shore in Black Sea, passing in transit shall not be more than 9 in peace time and these warships shall not be in Black Sea more than 21 days and shall not carry load more than 30.000 tons. Submarines, aircraft carriers and vessels more than 15.000 tons shall not pass to Black Sea through Straits.

i) Passage Regulation from Turkish Straits by Montreux

The “freedom of navigation” forms the core of Montreux Convention. This freedom type is the navigation norm which is effective in world’s seas at the period in which the Treaty was signed. Relatively small dimensions of vessels and thus less severe sea accidents not capable of creating significant threat in contrary to the cases in today had freedom of navigation functional. However due to the shipment concept which has changed after II World War, consequently “increasing vessel tonnage” and thus sea accidents which exhibit “catastrophe” dimensions and environment conscious, “innocent passage” condition was added.

“The freedom of navigation right which Montreux Convention that is a consequence of Mare Liberum period includes was evolved as “innocent passage right” in Maritime Law Agreement in 1958 and 1982. Consequently the freedom of navigation was

superseded by norm in the form of “innocent passage” with the first Maritime Law Agreement (Akten, 2003).

Montreux Convention which is exclusive and named as “sui generis” in law terminology consists of 2 article and regulates the passage of either military or commercial vessels. Turkish Straits have a passage regime which is not similar to any other straits in respect to law. The passage conditions of commercial vessels were regulated by the first 7 article. According to the 2nd article of treaty vessels passing non-stop have “completely free” passage right regardless of their flags or loads whether it is day or night. The “free passage” terms in 2nd article stress “completely free” passage right in high seas.

The definition of passage rights through Turkish Straits has explained to the participating foreign delegates by Tevfik Rüştü Aras who was among Turkish delegation as “innocent” and it was clearly emphasized that Türkiye reserves criminal and administrative authority. There was no any claim against this opinion. This means that the passage from the straits shall be “innocent” and Türkiye reserves the right to regulate and control it.

Innocent passage is the passage which is not prejudicial to peace, good order, or security of a coastal state. If any sea accident (fire, slap, collision, sinking, explosion, capsizal, running ashore etc.) which a vessel may involve or cause during passage, possesses threat for environment, health and life the passage becomes “non-innocent”.

Non-innocent passage occurs not only as a result of sea accidents. Release of ballast waters deliberately or unintentionally to sea by a ship, imprudent transition of a ship exposed to a epidemic detrimental with respect to health or navigation not complying with Traffic Separation Regime which coastal state predict and related to its order.

Freedom of navigation, in one sense had new dimensions in line with universal developments, turned into “innocent freedom of navigation” that is “secure innocent passage” form by keeping in mind security of environment, health and life aspects. The navigation freedom in Turkish Straits also is in the form of “innocent navigation freedom” which is abbreviated as innocent passage in light of this universal theory. (Akten, 2003).

For the first time in international law “transit passage” regime (transit regime) was adopted with 1982 Sea Law Convention (United Nations Sea Law Convention, transit passage, article 37-44). Transit regime is a navigation norm which establishes broader rights to vessels, lessens their obligations, therefore restricting the control of coastal state compared to innocent passage. Rights and obligations are two concepts complementing each other. Right of any party requires obligation for other. Innocent passage grants some rights the vessels and coastal state and charge some obligations. In case of transit passage, the rights of vessel are extended with respect to innocent passage and obligations are lessen. This means that the rights and obligations of a coastal state against transit passing vessel are constricted with respect to innocent passage” (Oral, 2003).

“Transit passage right includes warships that is covers all vessels. Passage should be done continuous and fast as in innocent passage”

The elements of innocent passage are:

1. innocent navigation,
2. compliance with formalities,
 - tax, duty, toll payment obligation (Montreux Convention, article.2/1 and 2/2)
 - fulfilling the obligation of notification (Decree of Turkish Straits, Article.6; IMO Resolution A.851(20)

“States have right to prohibit the non-innocent passages. This right is given by Sea Law Treaty (1982 United Nations Sea Law Treaty). This right is also takes place within Montreux Convention providing that formalities were fulfilled”.

“The rights and obligations of vessels passing continuously are as follows:

The rights of vessels passing through straits

-Rights defined in Montreux:

- § Benefit from freedom of navigation,
- § Benefit from lighthouses / navigational signs,
- § Benefit from rescue (lifeboat service) services,
- § Benefit from pilotage services (upon request),
- § Benefit from ship health services,
- § Benefit from towing services (tug boat) services.

-New services

- § VTS service,
- § Escort service.

2. *The obligation of vessels passing through straits:*

1. *before passage*

- § deposit charge for lighthouse,
- § deposit charge for rescue,
- § paying for patente charge,
- § comply with the requirements of TUBRAP

(submitting written navigation plans, sailing plans, oral position and calling point reports)

2. *during passage*

- § innocent passage” (Arslan, 2005).

“Montreux Convention has not provided a regulation to all legal issues that might arise due to passage of vessels from Turkish Straits. *“The polis and jurisdiction authority of Turkiye and right to request innocent passage are reserved providing that clear restrictive provisions are not infringed, the essence of passage right is not interfered and general rules of sea laws related to straits are obeyed.”* However Montreux Convention also stipulated in preamble part the protection of the security of Turkiye, but the issue about how this security would be ensured and what kind of measures might be taken is left to Turkish State” (Çağa, 1994).

The Issue of Straits was discussed again in 1945 in Yalta and Potsdam Conferences among Allies, but clear and definite agreement was not obtained. The Issue of Straits which was in international agenda after 2nd World War was discussed among states. Soviet Union claimed that political situation has changed and therefore some modifications complying with new conditions should be made to Strait Regime. Adducing that Turkiye doesn't comply with Montreux Convention, Soviets claimed that Straits to be closed for the warships of states without coast on Black Sea and to be kept opened always for states having coast on Black Sea for her own security During World War II. They also requested that the passage regime for straits should be arranged by Turkiye and the coastal states of Black Sea only. On the other hand Soviet Union asked to defend the straits cooperatively by Turkiye and Soviet Union in order to prevent hostile usage of Straits. They notified Turkish Government by two diplomatic notes about these requests on August 7th 1946 and September 24th 1946. USA and England accepted the proposal of Soviet Union since they are not against for a new regulation on Straits but the other western countries proposed that the Regime of Straits should be discussed within the framework of Montreux Convention in an international meeting. They didn't accepted bilateral negotiations between Turkiye and Soviet Union. The Government of Turkiye answered the notes of Soviet Union by two diplomatic notes given on August 22nd 1946 and October 18th 1946, which indicating that she accepts modification on Regime of Straits in principle but it should be discussed in an international meeting. In these notes it was

also clarified that cooperate defense requirement is definitely not acceptable (<http://www.dallog.com/kavramlar/bogazlarmes.htm>, April 23, 2006)

2.1.5 Current Situation

Various significant political and military developments taken place after 1946 and afterwards caused attempt of holding and international meeting futile and there were not any modifications on regime of Straits. Thus the provisions of Montreux Convention have been into effect without any modification until today.

Many rule and definition of Montreux Convention signed in 1936 doesn't describe the realities of today such as weapon systems, the classification of warships. The last provisions of Treaty which envisages the modification of Treaty with respect to current discussions are important, too. Article 28 defines the validity period of the Treaty as 20 years and then describes the freedom of transit and navigation shall continue without limit of time and perceives only a preliminary notification by a party adequate for abolition. However the amendment of Treaty is more difficult and troublesome. According to the Article 29, at the expiry of each period of five years from the date of the entry into force of the Treaty each party entitles to initiate a proposal for amending one or more of the provisions of the present Convention. To be valid, any request for revision formulated by one of the Parties must be supported, in the case of modifications to Articles 14 or 18 by one other Party, and, in the case of modifications to any other Article, by two other Parties. Should it be found impossible to reach an agreement on these proposals through the diplomatic channel, the Parties agree to be represented at a conference to be summoned for this purpose. Such a conference may only take decisions by a unanimous vote, except as regards cases of revision involving the amount of warships passing straits altogether and total tonnage of non-Black Sea warships in Black Sea, for which a majority of three-quarters of the Parties shall be sufficient. The said majority shall include three-quarters of the High Contracting Parties which are Black Sea Powers (Akgün, 2006).

According to Prof. Sevinç Toluner who is the leading sea lawyers of Türkiye, with these provisions the Parties “have expressed their intention to maintain and reserve the free passage principle which international law predicts in case Montreux Convention abolishes”. When taken into account that the 1st Article of Treaty doesn’t discriminate between war and commercial vessels, it is clear that the freedom of passage will be applied for warships in new regime.

Additionally in accordance with the decision given by International Court of Justice on April 9th 1949 following the discussions on problem arising from two British destroyers hit to mines laid by Albany on October 22nd 1946, the registration of the right for warships to facilitate innocent passage indicates that if Montreux Convention is not replaced by a special convention the same right will be requested for passage from Turkish Straits. Because Convention on Continental Waters and Adjacent Regions dated 1958 and UN Sea Law Convention dated 1982 doesn’t discriminate warships and commercial vessels in facilitating innocent passage and transit passage right. In case of abolition of Montreux Convention in any manner whatsoever, freedom of passage principle may be granted as a right originating from international law. However Montreux Convention prevents the passage of aircraft carrier and submarine of non-Black Sea powers into Black Sea. The total tonnage of warships that may enter Black Sea is also restricted to 45000 tones (Akgün, 2006)

Turkish Straits is an inland water route which is subjected to an international agreement and also an important strait which is “used for international marine transportation”; they cannot be defined as “high sea” or “an international water route”. As a matter of fact in the Section of Straits of 1982 UN Sea Law Convention has no term for “international water route” because states have paid attention to keep straits within their continental waters away from being defined as “international” that is a “high sea” (Oral, 2003).

When modification of Montreux Convention is in question, necessary modifications shall be made by taking into account the ecological, cultural, geographical, historical, and geopolitical characteristics of Turkish Straits, international rules and law. Having control on the regime of Straits has always been strategically advantageous for Türkiye along history.

1994/1998 Regulation on Turkish Straits Passage Regime is significant since it can be taken as recognition for Türkiye's authority on Straits by world and it is an example of exercising of this authority, in addition to the importance for the safety of navigation that it established. This means that Türkiye doesn't exercise what she wants but steps in when a present threat rises or rules are violated. The important thing is that this was realized without detriment to the sovereignty, the unity and security of Türkiye (Oral, 2003).

2.2 Control of Turkish Straits By VTS System In Türkiye

Throughout the history, Turkish Straits (Figure 2) were compared to other channel systems by Russia and other countries with the hope to be controlled, and the applications herewith were put forward to take channels' control from Turkish Government. Primarily Panama and Suez Channels are not natural water channels but made up, and there are strict restrictions regarding vessel passages including not to use propeller in certain areas, and obligation to hire pilot captain. Considering vessel passages, 24-25 thousand vessels Per year pass through Suez, 14-15 thousand vessels pass through Panama whereas 3-4 times more vessels than this amount passes through Turkish Straits (<http://www.denizhaber.com>, April 23, 2006).



Figure 2.1 : The Strait of Istanbul

Besides, Panama and Suez Channels do not pass through a city like Istanbul where 15 million people live. Again, when we consider Malaga Channel, another big passage, we see that its width is 16 sea miles which is almost equal to the length of Strait of Istanbul. This proves that Strait of Istanbul is a very special passage, can not be compared to the other water channels on the world, and that it requires special arrangements. It is obvious that the historical and natural damage which will be caused by an accident which might occur as a result of high tanker traffic, shall not be less than the damage caused by a possible earthquake in Istanbul. Independenta and Nassia accidents can be given as examples to this vision (<http://www.denizcilik.gov.tr>, May 12, 2006).

Turkish Straits are not international channels but are water channels which are under the rule of Turkiye and open to international use. Montreux Convention for Channels signed on July 20,1936 clearly states that Turkish Straits are under the control of Turkish Republic. The passage regime applied in this water strait which is open to international use is named and defined as Montreux Convention “harmless right of passage”. This means free cruising without causing harm. Harmless passage includes some elements determined by the Montreux Convention.

These include;

- Harmless cruising,
- Obeying formalities,
- Tax, fees, official payment charges (Montreux Convention, a.2/1 and 2/2)
- Performance of declarations (Turkish Straits Channels Regulations, a.6; IMO Resolution A.851(20))

Turkish Republic Government, the owner of the Turkish Straits, and vessel corporation which uses the Turkish Straits, have mutual rights and responsibilities within the frame of a responsibility agreement. Straits of Çanakkale and Istanbul should be protected from the affects of increasing traffic, with the performance of the rights and obligations

2.2.1 VTMS (Vessel Traffic Management and Information System) of The Turkish Straits

a) Before VTS Traffic System in Turkish Straits

Before signing of the Montreux Convention (1923 – 1936), channels were governed by an international commission. The period following the signature of the Montreux Convention can be separated into two parts; before and after July 1,1994 (the date when Turkish Straits Navigation Traffic System Regulation came into force.)

- Ø “Before July 1,1994 international cruising rules COLREG – 1973 (International Regulation On Preventing Conflict In The Seas) were applied.
- Ø After July 1,1994 Regulation on Turkish Straits and Marmara Region Navigation Traffic Arrangement came into force, which came into international use upon approval by IMO Navigation Security after November 24,1994. Türkiye established Traffic Separation Schemes:TSS in Turkish Straits with this

regulation, and these TSS's were approved by IMO specialists. Some innovations brought by the regulations are as follows:

- Cruising Provisions were based on IMO recommendation rules.
- 10th rule (Traffic Distinction Arrangement) was taken as a basis instead of COLREG – 73 9. (Cruising in Narrow Channels), and Traffic Distinction and formed according to “Ships Routing” in IMO's decision no: 4472/14 became valid” (Bakırcı&Etyemez, 2005).

Decision 9 clearly states that; “A vessel proceeding along the course of a narrow channel or fairway shall keep as near to the outer limit of the channel or fairway which lies on her starboard side as is safe and practicable” (Aybays &Oral, 2005).

- Reporting System came into force (Cruising Plan 1, Cruising Plan 2) and position report,
- Conditions of passage in Flux and Fog, and conditions of controlled passage, and conditions in which the Channel shall be closed to passage are defined.
- Big vessel (longer than 200 m), vessel with deep draft (draft ≥ 15 meter) and air draft (58 m) definitions are made, and administration is given the authority for evaluation and determining passage conditions.

Upon effect of Regulation dated 1994 numbers of accidents between 1994-2000 are given in Figure 3 and Figure 4 (Bakırcı et al, 2005).

Number of tanker accident between 1994-2004 years is shown Figure 2.2 ve Figure 2.3 de gosterilmistir (Bakırcı et al, 2005).

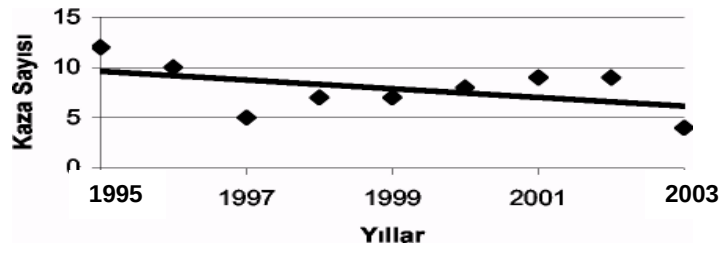


Figure 2.2 : Tanker Accident in Strait of Çanakkale between 1995-2003

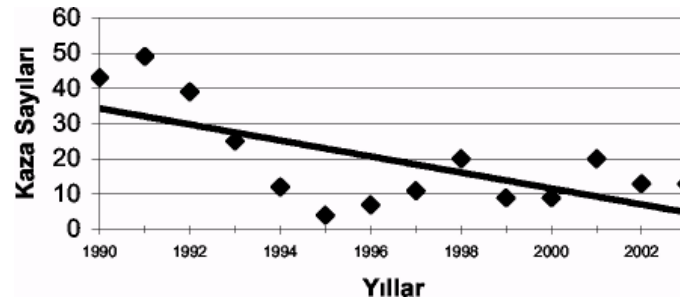


Figure 2.3 : Tanker Accident in Strait of Istanbul 1990- 2003

Considerable decrease was observed in accident amount upon effect of the Regulation. Specifically 1994 statistics were; 2 accidents occurred in the second half of 1994 upon whereas 10 accidents occurred in the first half of 1994. (http://denizhukuku.bilgi.edu.tr/doc/turk_bogazlarinda_trafik_sistemi_gelismeler_ve_sorunlar.doc, July 26 2004)

Though the Regulation carried main issues which can be considered as the essence of Regulation 1994, it contained new definitions. A great reform was realized as Turkish Straits Navigation Traffic Arrangement Regulation, and Turkish Rule on the Channels was proved. (Bakırcı&Etyemez, 2005).

b) Basic Navigation Rules of 1998 In The Turkish Straits

Considering so-called deficiencies by other countries in 01.07.1994 Regulation, special case of the area, and latest arrangements by IMO, a new Regulation was prepared and brought into force on 06.11.1998.

- a) *Main Rule*: TSS, established for the vessels which will pass through Turkish Straits, covers Strait of Istanbul, and the vessels are obliged to cruise according to these lanes (Figure 2.4).
- b) *Vessels longer than 200 m*, can not stay in TSS lane in some sections of Strait of Istanbul, therefore we should not compare these vessels to any other vessel in Strait of Istanbul longer than 200 m. However, comparing these vessels with 50m, 100m vessels which are used in local traffic would be convenient (Figure 2.5).
- c) *Operation of the Rules*: Until a vessel longer than 200 m leaves the Strait of Istanbul, another vessel with similar length shall not be allowed for entry, but smaller vessels might be allowed. COLREG 9 rule is valid for all passing vessels through Strait of Istanbul.
- d) *When big vessel leaves the Strait of Istanbul*: When a big vessel leaves the Strait of Istanbul, the TSSs which were suspended for a while become valid and then the passing vessels cruise within the lanes as required in TSSs.
- e) *When vessels longer than 300m* ask to pass through Strait of Istanbul, since the danegr is much bigger, not any vessel is allowed for passage. Vessels which pass without permit are subject to COLREG Rule 9(Figure 2.6).

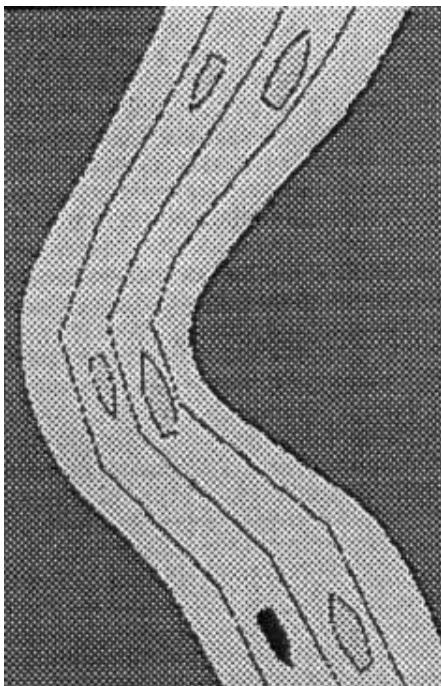


Figure 2.4. Vessel shorter than 200 m and
Passage in TSS

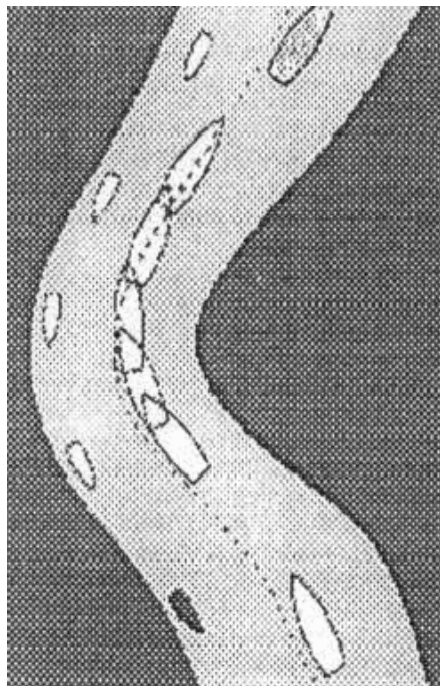


Figure 2.5. Passage of vessel longer than 200
m in according to COLREG Rule 9

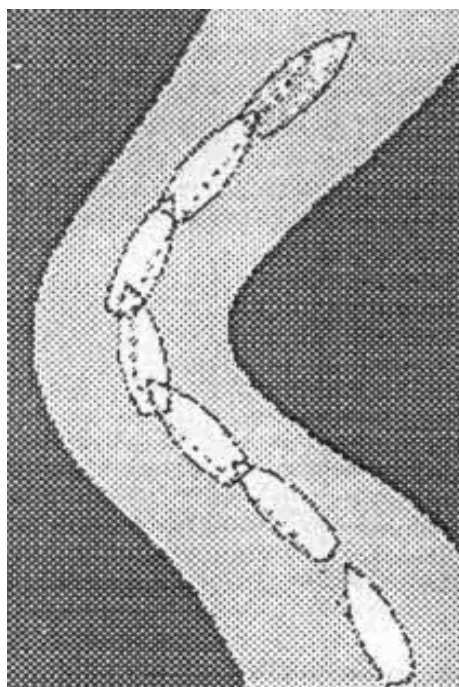


Figure 2.6. Passage of vessel longer than 300 m
In according to COLREG Rule 9

c) After VTMISS In Turkish Straits System And New Traffic System

Vessel Traffic Service (VTS) (Figure 2.7), system supports vessels passing through Turkish Straits by monitoring them by trained personnel. This cruising and monitoring system is used since 1994. However, VTS system which costs 45 million USD, is a highly technological system. System is funded by lighthouse, and health prices as required in Montreux.



Figure 2.7. The Unmanned Remote Sensor Stations (RSS)

The system aims to monitor and control navigation traffic by minimizing the accident risks which arise from vessel traffic, and provide security in the Turkish Straits Region. It also aims to increase the effectiveness of the current “Turkish Straits Navigation Traffic Arrangement Regulation”, and is in force since 30.12.2003. VTS, operated by Coast Security Vessel Rescue Management, has proved a successful performance during the last one year, and provided the safe cruising security of Strait of Istanbul and Strait of Çanakkale with a good management arrangement. (Bakırcı&Etyemez, 2005).

The Vessel Traffic Management and Information System shall collect, process and disseminate information on the marine operating environment and maritime vessel traffic in the Straits. The System is to provide the mariner with the information necessary to prevent or avoid collisions, rammings and groundings. The System shall also support emergency measures in cases of casualties, through

exchange of information with appropriate bodies. According to Montreux Convention; the sea vehicle which is using innocuous transpassing right, there have not been any intervention by authority Although the sea vehicle disobey to directions and instructions. The intervention can be done when the transpassing became fatal (Denizcilik Müsteşarlığı, 2006).

This system uses radar devices as primer and the most important sensors, precisely defines position via satellites, includes meteorological and oceanographic sensors, night and day cameras, communication systems, record and re-monitoring systems, other hardware, and application software.

System follows each vessel's movement independently and is sensitive to the movements of the vessels according to each other. Makes necessary warnings for close passage, close follow-up, crash, bunking risks, ad all these activities can be recorded. 360° rotating radar antennas target the vessels. "Sector closing" operation during rotation of the antenna towards the land does not allow broadcasting. Therefore, mentioned radar devices do not emit radiation in levels which might threaten health.

2.2.2 Functionalities and Navigational Aids to be Provided by the System

The VTMISS shall provide:

- Detection and localisation of vessels in the VTS areas,
- Identification of the newly detected vessels,
- Continuous tracking of the vessels within the VTS areas,
- Early prediction of the possible development of dangerous situations (close encounters, leaving of the fairway),
- Promulgation of navigational information and general warnings,
- Transmission of individually addressed information and warnings,
- Transmission of individually addressed navigational advice,

- Traffic organization,
- Recording of information necessary for the purpose of documentation of the vessel traffic movements and information and advice provided, to be used for casualty investigation and statistical evaluation,
- Co-operation with other services,
- Reception and transmission of non-traffic related messages from/to individual ships or the general vessel traffic,
- Reception and transmission of messages with other authorities or commercial organizations,
- Information exchange between the VTC's of the Istanbul and Çanakkale,
- Control and prevention of marine pollution (Figure 9),
- Control of sensitive areas as a automatic

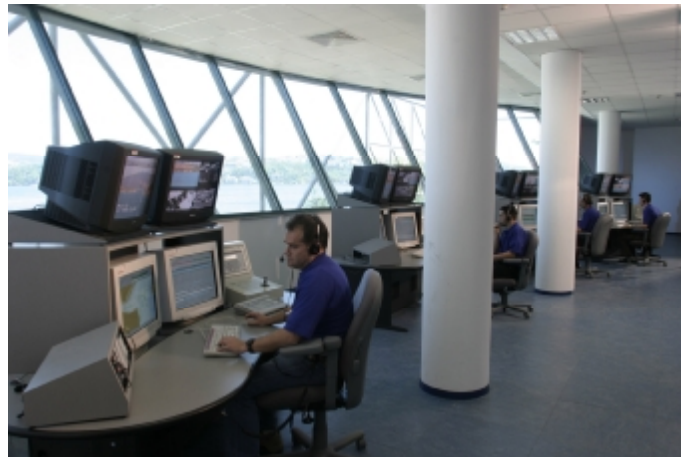


Figure 2.8. The Vessel Traffic Control Centre

There shall be two VTS (Vessel Traffic Services) areas, one for Istanbul and one for Çanakkale area each with a Vessel Traffic Control Centre (VTC). Surveys studies made show that it will be possible to provide a very reliable “Independent Surveillance” of two straits using eight Remote Sensor Sites (RSS) in The Strait of Istanbul and five RSS in The Çanakkale area .

Each RSS will have a duplicated radar for day and night and all weather surveillance as well CCTV and IR cameras for day and night viewing of the traffic in The Straits. The VTMISS System will also have “Dependent Surveillance” element which will make use of Direction Finding and GPS navigational satellites to obtain accurate positional and identification data for vessels carrying dGPS transponders.

Moreover, the VTMISS System will have various navigational aids such as Racon’s and meteorological and hydrographic sensor which will provide information to enhance the safety of navigation in The Straits.

2.2.3 The Main Constituents of the VTMISS

- Two Vessel Traffic Control Centres (VTC), one each in the Istanbul and Çanakkale VTS Areas.
- 13 Unmanned Remote Sensor Stations (RSS), 8 in Istanbul and 5 in Çanakkale VTSA’s.
- 2 dGPS Reference Stations, 1 in Istanbul and 1 in Çanakkale VTSA’s, and 50 dGPS transponders.
- 4 VHF/DF Stations, 2 in Istanbul and 2 in Çanakkale VTSA’s.
- 5 Racon Station, 4 in Istanbul and 1 in Çanakkale VTSA’s.
- 5 Automatic Weather Stations (AWS), 3 in Istanbul and 2 in Çanakkale VTSA’s.
- 5 Surface Water Measurement Sensors (SWMS), 3 in Istanbul 2 in Çanakkale VTSA’s.
- 3 Salinity Temperature Profilers (STP), 2 in Istanbul and 1 in Çanakkale VTSA’s.
- 10 Doppler Current Sensor Stations (DCS), 5 in Istanbul and 5 in Çanakkale VTSA’s (<http://www.denizcilik.gov.tr/ilan/gtybs1.htm>, November 17, 2005).

- 14 pieces doppler stream sensor station,
- 13 pieces close cable tv network system and sensitive cameras, registration and audit sections,
- 24 pieces VHF, 2 pieces MF/HF radio-set,”

The architecture shall follow the ISO Open System Interconnection (OSI) Standards and shall use modular design to extend capabilities and insert state-of-the market technology in future incremental builds.

2.2.4 Status in the Straits by VTS System

26 accidents occurred in year 2004 following adopting of VTS system. This number is the maximum accident amount for the last 10 years. Number of accident in the first 6 months of 2005 is 15. 2 accidents occurred in Strait of Çanakkale in 2004. After all, 10 accidents occurred in first 6 months of 2005 which is the highest number of the last 9 years. 10 years generalization indicates that accidents in Boshorus increase while accidents in Strait of Çanakkale decrease.

Foundations and Agencies which shall utilize from the information produced by the system:

- Transit and non-transit vessels,
- Agencies,
- Fire fighting, environment protection and rescue units,
- Guidance units based on the coast,
- Towing, and escort units,
- Harbor Head Offices,
- Foreign harbors which request information,
- Turkish Judgement Offices,
- International foundations,
- Customs,
- Coastal Medical Units,

- Coast Patrols,
 - Naval Forces Command Units,
 - Ministry of Foreign Affairs,
 - Undersecretariat for Navigation,
 - Other related foundations and organizations
- (<http://www.denizcilik.gov.tr/ilan/gtybs1.htm>, November 17, 2005).

2.3 Recent Developments Regarding Turkish Straits

Since 1936, Türkiye has never hindered sea traffic in the Straits. Türkiye has modernized the ship traffic system in the Straits, over 50,000 ships pass in a year, by spending millions of dollars and provided this money from its own sources. Türkiye has practiced Montreux Straits Convention in a fair way and has never experienced any kind of problems with the other countries. Together with qualified personnel and high-tech zodiacs of Turkish Coast Guard serves in a perfect way for the transportation of Central Asian Oil to the world market together with assisting tanker pass. In this way Türkiye has served and contributed to world economy, regional development and world peace (Ozturk, 2006).

Mainly based on the Montreux Straits Convention decisions; despite the heavy traffic in the Straits Türkiye has been working on providing “secure free pass” accordance with the international agreements in which Türkiye has been a party and regional formations. In accordance with the first 7 articles of the Montreux Straits Convention and international agreements, the vessels cruising Turkish Straits are not obliged to have maritime pilot and tugboat. However Türkiye encourages the vessels cruising the Straits to have maritime pilot who knows the region well because of the geographical condition of Turkish Straits, previous tanker accidents and statistics. Moreover Türkiye strongly recommends having maritime pilots in international meetings (Table 1).

Table 2.1 : Continue and Discontinue Vessels and Maritime Pilot Usage (T.C. Presidency State Supervision Board Publication, 2004)

Year	Strait of Istanbul				Strait of Çanakkale			
	Passed Vessel	Discontinue	Continue	Turkish Pilots Usage	Passed Vessel	Discontinue	Continue	Turkish Pilots Usage
1995	46.954	22.629	24.325	17.772	35.459	12.210	23.249	8.292
1996	49.952	26.197	23.755	20.317	36.198	12.126	24.072	10.307
1997	50.942	26.672	24.270	19.753	36.543	11.875	24.668	11.047
1998	49.304	24.743	24.561	18.881	38.777	13.641	25.136	11.448
1999	47.906	21.583	26.323	18.424	40.582	13.682	26.900	10.002
2000	48.079	21.221	26.858	19.209	41.561	14.528	27.033	11.130
2001	42.637	16.524	26.113	17.767	39.249	12.797	26.452	10.704
2002	47.283	17.885	29.398	19.905	42.669	12.769	29.900	12.164
2003	46.939	17.988	28.951	21.175	42.648	13.534	29.114	13.020

*Numbers written bold indicates that maritime pilots less than the number of discontinue vessels has been used. (Number of vessels with the Turkish flag who don't have to have maritime pilots is not mentioned.)

2.3.1 Effects of Oil Pipeline Projects

Recently as a result of growing importance and production of Caspian and Caucasus oil in the Central Asia, transportation of oil by sea has been started to discuss. During the last years because of the recent technological developments in shipbuilding and Caspian Oil being presented to the world market, there has been a serious increase in the number and tonnage of the vessels cruising and kinds of hazardous cargo transported has been varied. The number of vessels passing Strait of Istanbul is increasing every year. In 2001, 42,637 vessels passed from Strait of Istanbul and in 2004 this number has increased 30% and raised up to 54,564. In the first 9 months of 2004, the number of continue vessel is 41,122. In the previous years while the percentage of vessels with hazardous cargo was 10 % by the end of 2003

this percentage went up to 19 %. Four years ago while the amount of oil and oil products transported through Strait of Istanbul was 65 million tons per year, by the end of 2003 this amount went up to 135 million tons (www.turkishpilots.org.tr, March 22, 2006). Again in 2001 number of tanker with hazardous cargo was 6,516, in 2004 this number went up to 9,399 with 50% increase. In 2001, 101 million tons of hazardous cargo transported through Strait of Istanbul and this number went up to 144 million tons in 2004, with 48% percentage. In the first 9 months 2005 the amount of hazardous cargo transported by the vessels through Strait of Istanbul went up to 108.123 million tons (www.denizhaber.com, November 11, 2005).

However transportation of Caspian Oil through the Straits and relating this to Baku- Tbilisi- Ceyhan (BTC) Pipeline Project is not a logical approach. Because Turkish Straits are under the threat of accident at all times and it is a waterway that can allow only a limited number of vessel pass. Passing the Turkish Straits has to be made in accordance with national and international regulations so that there wont be an increase in the sea traffic on the contrary there may be delays and increase in the vessels waiting. If the number of the vessels approaching the waterway with a limited capacity increases, the possibility of their being there increases at the same time. For example on condition that 200 vessels pass within a month through the straits, waiting period can go up to 11 hours in order to provide safe and secure pass. Moreover if the pass regulations are practiced as a result of the transportation of Azerbaijani Oil in the amount of 36 million tons per year with the vessels of 100,000 tons ($250m < L < 300m$) the Straits should be closed for the traffic for 180 days per year (Ince&Sevgi, 2006). In this case the projects like Baku- Tbilisi- Ceyhan (BTC) Pipeline Project, the project of the century, will lower the amount of the oil that will be carried through the Straits and prevent the delays stemming from waiting. Alternative routes for the transportation of Caspian Oil from Black sea is given at Table 2 (Cavoulacos, 2006).

Table 2.2 : Black Sea - Crude Oil Export Alternatives Bypassing The Straits(Cavoulacos, 2006).

Bypass Pipeline	Length (km)	Comments
Odessa - Brody Plock – Gdansk	1.480	High investment; export terminals in Gdansk & Rostock can be used; potential problems with the Danish Straits
Constanta- Trieste	1.375	Relatively high initial investment requirements; direct pipeline supply of Central European refineries with Caspian crude through the Trans-Alpine Pipeline (TAL)
Burgas-Vlore (AMBO)	913	Long and mountainous route; relatively high initial investment requirements; supply to refineries along the route in FYROM & Albania; challenging financing due to political risk
Burgas- Alexandroupolis (BAP)	256-279	Short route; smooth terrain; relatively low initial investment requirements; studies and design ready; permits (including first stage EIA) obtained, therefore fast implementation feasible; diversification of crude oil supply routes, cost efficient, comparable with the Straits, European Union corridor
Kiyikoy - Ibrikbaba	200	Short route smooth terrain; relatively low initial• investment requirements; Russian and Caspian Black Sea exports depending on one country
Samsun - Ceyhan	510-560	Long and mountainous bypass route; Caspian exports depending on one country; use of BTC pipeline corridor; supply to Kirikkale refinery

Approximately 12 million of people live in the coastal area surrounding Turkish Straits. According to the research conducted by Maritime Security Institute, world's most important maritime security and research institute, any possible LPG tanker explosion that may happen in a narrow water way will threaten the life within an area of 3 kilometers and it has been predicted that an earthquake with 7,5 frequency will happen within an area of 20 km² (www.denizhaber.com, November 21, 2005).

2.3.2 Marmaray Project

In addition to these risks, big projects about transportation has been carried out in Turkiye especially to relieve the traffic jam in Istanbul, a sea pass combining Anatolian and Rumelia sides has been given importance (Figure 2.9). The latest and biggest project that has been carried out on this matter is the Marmaray Project.



Figure 2.9: A Scenery of Strait of Istanbul (Canbolat R., November 21, 2005)

When this project carried out to minimize risks displayed by vessels of local traffic cruising between Sarayburnu and Uskudar 3000 times a day and transporting approximately 2 million people has been completed, it will be possible to switch continent within 4 minutes even under worst weather conditions.

Within the scope of the efforts of carrying out Marmaray Project, there has been a crises center established by Coast Safety and General Directorate of Ship Rescue and it has been provided that necessary precautions related to sea operations of Marmaray Project has been taken and the follow up has been provided. Crises Center determined that the area from Strait of Istanbul Bridge at north, to the line combining Inciburnu mole lighthouse and Ahirkapi lighthouse at south is the sea area risk region in terms of local and international sea traffic.

The total line length of the project is 76,3 m and 1,4 km will be immersed tube tunnel bypassing Strait of Istanbul (Figure 2.10) (www.marmaray.com.tr, May 3 2006).



Figure 2.10: Strait of Istanbul Passage of Marmaray Project

In case of emergency that may come up during the Project, 3 rescue and extinguishing tugboats will be waiting at Harem Station. In accordance with the international regulations, 3 red and 2 green buoys have been placed and these buoys will change place in case of phase changes and this will be announced by The Head of Cruising Hydrography and Oceanography Department. During the implement of this project, cruising area of Strait of Istanbul will be narrowed up to 317 meters. For this reason, the vessels passing by the Straits should act in accordance with local and international rules in accordance with the Turkish Straits Sea Traffic Regulations Act, they should provide correct and accurate information in time, they should have maritime pilots during the project for their own safety and in case of an unexpected risky situation using escort tugboats is one of the important precautions to be taken (www.denizhaber.com, January 17, 2006).

2.3.3 Situation At The Strait of Çanakkale

In Strait of Çanakkale, similar to the one in Istanbul Strait, every year the number of bypassing vessels is rising. According to the latest data in the year 2005 the number of vessels passing Strait is 49,077 (Figure 2.11).



Figure 2.11 : A Scenery of Strait of Çanakkale

Approximately 134,000 vessels pass by straits per day and 4,090 vessels pass by straits per month. 8,813 of these bypassing vessels are tankers. 1497 of these tankers are with chemical cargo, 752 of them are LPG and LNG tankers, 6564 are the tankers with regular cargo. In the recordings, there happened 5 sea accidents at Strait of Çanakkale and 2 of them are only crash and 3 of them were vessels striking ground.

2.3.4 The EU And Marine Studies

While the negotiations of full membership of Türkiye to the EU has been carried out, the EU also has been following the studies conducted about the sea technologies. A number of studies and projects has been carried out in accordance with the EU efforts to develop the sea technologies. Within the scope of framework program carried out by The European Union Research and Technology Department, *Safer Ship Operation* related to sea safety and transportation of the passengers and cargo in a secure way has been conducted and studies on environment protection has done. The European Union contributed 50 million Euro for 55 projects related to the sea way transportation. Moreover studies on providing and increasing ship operation safety has been supported by the European Union (Ece, 2006).

One of the projects on the development of sea technologies that has been carried out by the European Union is the GALILEO, European Satellite Navigation System Project. GALILEO project with the purpose improving technology for better cruising conditions, also aims at new approaches for fishing, oceanography and tanker accidents. All sea transportation can benefit from the GALILEO program that can be used under all weather conditions at sea, coast or port approach and port maneuvers. At the same time this project will be useful for Automatic Identification System (AIS) that has been practiced by International Maritime Organization (IMO) to provide cruising safety and prevent crashes. Also this project will additionally be helpful for Ship Traffic Management Systems and include the studies for the AIS liability. Within the scope of GALILEO Program, information about hydrographic researches, stream and tide will also be included (Ece, 2006).

Countries that know the importance of the sea for human beings put regulations into practice in terms of the protection of ecological balance and determining special areas according to IMO. In this matter according to PSSA criteria, working as a sub committee under IMO-MEPC committee, sensitive sea areas on earth are being determined and regulations like rules, decisions or prohibitions about these areas have been explained. The following PSSAS(Particularly Sensitive Sea Area) have been designated by IMO:

- the Great Barrier Reef, Australia (designated a PSSA in 1990)
- the Sabana-Camagüey Archipelago in Cuba (1997)
- Malpelo Island, Colombia (2002)
- the sea around the Florida Keys, United States (2002)
- the Wadden Sea, Denmark, Germany, Netherlands (2002)
- Paracas National Reserve, Peru (2003)
- Western European Waters (2004)
- Extension of the existing Great Barrier Reef PSSA to include the Torres Strait (proposed by Australia and Papua New Guinea) (2005)

- Canary Islands, Spain (2005)
- the Galapagos Archipelago, Ecuador (2005)
- the Baltic Sea area, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden (2005) (<http://www.imo.org>, May 15, 2006)

Working as a committee within the scope of IMO studies, established in 60s, being active in more than 90 countries and have more than 5 million supporters; WWF (World Wildlife Fund) determined Istanbul and Strait of Çanakkales and Marmara Sea as one of the 9 areas on the world that is in danger because of its geographical location and biological variety.

The document named “Identification And Protection Of Special Areas And Particularly Sensitive Sea Areas” and numbered 52/WP.12 prepared by IMO explained the criteria for the protection of sensitive areas and has been approved by member countries. The characteristics of the region announced as sensitive area by the IMO before shows that particularly when we think of Turkish Straits and the ecological condition of Marmara Sea, there should be a special effort for Turkish Straits to be announced as a sensitive area.

2.3.5 Studies On The Control of Ballast Water

Sea water included in the ships in order to provide the ship's balance and maintain security under difficult sea conditions is named as ballast water and this water includes some kind of harmful water organisms and pathogens. Whenever there are appropriate conditions, ballast water allow this invader and harmful organisms to be carried to other seas. Moreover the types which are not in the present sea environment may become harmful when carried to the other environments and can spoil the region's ecological system. For example one of the important effects of ballast water is “Mnemiopsis Leidy” which is eating fish eggs and consuming fish stock in the Black Sea and harmful for economy. This bacteria is carried to Black Sea by ballast water.

Shellfish, fish and microorganisms even pathogens being carried out to different sea environments is one of the biggest risks threatening world sea environment. This situation effects the development of some species and it is harmful for ecosystem because it spoils the food chain. If there are no precautions taken in this matter, in a near future the harms caused by water organisms and pathogens carried by ballast water will go beyond the loss of environmental balance and its effecting human life in every aspect is a common belief shared by the scientists.

Turkish maritime area is seriously effected by water organisms and pathogens carried out by the ballast water. The fact that oil transportation route is from Black Sea to the other seas and the ships carrying oil coming to Black Sea unloaded results in these ships carrying ballast water instead of cargo. Finally Aegean Sea, Marmara Sea and Black Sea are the sea areas seriously effected by the water organisms and harmful pathogens carried with the ballast water.

In order to reduce the negative effects of water organisms and pathogens carried by ballast water, IMO (International Maritime Organization) and similar international mechanisms has launched studies like GLOBALLAST however hesitations about these studies containing all sea areas, based on factual studies, completed within a short period of time, the effect of precautions that will be implemented as a result of the outcome and this precautions being accepted in the international area requires that all these studies should be conducted nationally and be in cooperation with international studies.

Within the recent studies carried out to eliminate or reduce the negative effects of water organisms and pathogens carried the ballast water, preparing international regulations about ballast water management with comes first. For this reason, “the International Act of Control and Management of Ship Ballast Water and Sediments, 2004” has been accepted in 13 February 2004 at an international conference held in London and opened to signature. This act brings some new rules for the ships to be obeyed on the issue of management of ballast water and these practices should be

supported with some international precautions determined as a result of scientific studies and its efficiency should be increased. In accordance with the studies carried out by IMO, Under Secretariat for Maritime Affairs has decided on the following studies to be done in order to eliminate or reduce the negative effects of water organisms and pathogens carried the ballast water within their ecosystem;

- İ Sea traffic
- İ The amount of ballast water that has been carried
- İ Inventory of the carried harmful organisms and pathogens
- İ Determining the future trends
- İ Risk evaluation based on the harmful organisms and pathogens carried by ballast water
- İ Maintaining a database
- İ Going through the international regulations about the subject and determining international legislation
- İ Maintaining the national legislation
- İ Determining the administrative structure
- İ Determining present technical background and providing the necessary education system.

Within the scope of these studies “Control and Management of Harmful Water Organisms Carried by Ballast Water” project was launched on 21 July 2006 and it will be carried out by TUBITAK Marmara Research Center. This project will last for 2 years and in the end there a ballast water management system will be formed and studies will be done to minimize the risk for the seas surrounding Türkiye (Denizcilik Müsteşarlığı Arcieve, July 30, 2006).

In addition to the studies for the management for ballast water; there are precautions like using anti-fouling paint in the ships, ships carrying hazardous waste being double-hull ships and their being produced in accordance with the characteristics of the cargo. These studies has been carried out by IMO and there are also some guide books for the use of member states.

When the member states obey the regulations in these guide books, ecological risks stemming from the ships bypassing the straits will be minimized.

Our country is included in Regional organizations established with the aim of protection of Mediterranean and Black Sea and be a party for the Covenants. By this way, data and technology transfer is made available and good international relations are maintained. REMPEC (Regional Marine Pollution Emergency Response Centre for Mediterranean Sea) is one of these.

Turkiye is a member of the Mediterranean and Black Sea Port Control Memorandum and by way of raising the standards of ships below the set standards, protection of the sea area, providing sea security for ships carrying foreign flags which dock at our countries ports our country illustrates it's commitment to international agreements and protocols to which it is a part of. The Black Sea Government Port Control Memorandum dated 12 December 2000 and printed in Official Gazette no 24258 is in effect.

The Black Sea Region Government Port Control Information System (BSIS) has been operational since end of 2003.

Turkiye has funded activities on the following items in the Black Sea.

- general and process oriented surveys,
- time series studies and
- modeling activities for near time and/or real forecasting.

The changes in the quality and quantity of nutrients, phytoplankton and zooplankton are being monitored at two stations (one inshore station and one offshore station) at two-week intervals for one year. The time-series data is used to

study the biogeochemical processes of the Black Sea. At the end of this study some important biological characteristics (e.g. rates and period of growth, death and reproduction) of a few key species (the copepod *Calanus euxinus*, the ctenophore *Mnemiopsis* etc.) are also expected to be disclosed.

Previously (during 1998) 4 stations off Sinop in the central southern Black Sea were being monitored for a few oceanographic parameters over monthly intervals. Since January 1999, two stations (one shallow ~75m and one deep ~400m) are being sampled for their basic pelagic biological (chlorophyll, phytoplankton and zooplankton) and physical-chemical characteristics (temperature, salinity, nitrate, phosphate, silicate, Secchidisk depth etc.) at biweekly intervals.

At these two stations, chlorophyll, phytoplankton and nutrients (nitrate, phosphate and silicate) are being sampled from 7 different water depths (surface, 10m, 20m, 30m, 40m, 50m and 60 m). Phytoplankton and nutrient samples will be analyzed at the METU-Institute of Marine Sciences. For the measurement of basic oceanographic parameters (i.e. temperature and salinity), METU-IMS loaned an Acoustic Doppler Current Profiler to the Sinop Institute.

Zooplankton samples are being obtained by one vertical tow from the bottom to the surface at the shallow station and from the lower border of the oxic zone (approx. 150 m) to the surface at the deep station. Following net towing, gelatinous organisms (which are retained on a sieve) are counted and weighed individually for determination of their biomass. This is necessary for understanding the population dynamics of gelatinous organisms (mainly *Aurelia aurita*, *Mnemiopsis leidyi*, *Pleurobrachia pileus* and the new alien Actenophore *Beroe* sp), this information is not known yet but is very important for the understanding and modeling of the pelagic ecosystem of the Black Sea.

The proposed project is expected to result in the creation of a time-series data of basic oceanographic parameters. Due to practical difficulties, unfortunately such a time-series has not been available until now. Therefore, from the sporadic studies performed up to now, we have only a limited and very general understanding of the Black Sea ecosystem. By combining the data obtained from short-term sampling studies, the knowledge of the Black Sea ecosystem could be utilized to explain spatial and temporal characteristics as well as for better modeling of the ecosystem.

This project will also help, through transfer of technology and experience, from the METU-IMS, to the development of a new Institute (Sinop Fishery Faculty of Ondokuz Mayıs University, Samsun).

In 2003 The Black Sea Contingency Plan to the Protocol on Co-operation in Combating Pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations (Emergency Protocol), Volume I, Response to Oil Spills, 2003 in response to increasing intensity of oil transport and subsequent potential risk of oil spills was approved by the Black Sea Commission and signed by Romania, Bulgaria and Türkiye. Georgia, Russian Federation and Ukraine finalize their internal procedures for signing the Plan. The first steps towards practical implementation of the Black Sea Contingency are being undertaken by the Black Sea Commission institutional network in close cooperation with Oil Spill Preparedness Regional Initiative (OSPRI).

In accordance with the Protocol signed, Bulgaria, Georgia, Romania, Russia Federation, Türkiye and Ukraine are working on national emergency situation procedures, shore management regulations, provisions for necessary equipment and materials and a Black Sea Emergency Situation Plan against possible environmental accidents in the Black Sea.

In promoting the practical implementation of Black Sea Contingency Plan the BSC Advisory Group on Environmental Aspects of Shipping in 2005 the close with Oil Spill Preparedness Regional Initiative conducted the first Black Sea Training in Pollution Reporting (POLREP) under the Black Sea Contingency Plan and elaborated a detail schedule for conduction POLREP drills in 2006. Assisted by OSPRI the Advisory group adapted HELCOM Manual for the purpose of the Black Sea Contingency Plan and started to work on the improvement of the template for the Directory of Response Personnel and Inventory of Response Equipment, Products and Other Means Which Each Party Might Offer as Assistance in Case of the Activation of the Plan.

In January 2006 the first Black Sea BRAVO drill was initiated and conducted by Bulgaria, the second drill was repeated in the second quarter of 2006 by Georgia and elements of the Black Sea Contingency plan was tested in June, 2006 during bilateral Russian -Turkish exercise. (Tarasova, 2006).

Another important study carried out by the Under Secretariat of Maritime Affairs are the investments about preparing the risk analysis stemming from sea transportation, preparing sensitivity maps and establishing emergency center (Denizcilik Müsteşarlığı, August 12, 2006). Within the scope of these studies, joint projects and studies with the Ministry of Environment and Forestry are planned on the elimination of sea pollution and determining pollution level. Purpose is to be ready for emergencies first and to be in accordance with the EU regulations during the EU full membership process.

CHAPTER THREE

OCENOGRAPHIC CHARACTERISTICS OF TURKISH STRAITS SYSTEM AND THE BLACK SEA AND EFFECTS OF OIL POLLUTION IN MARINE ECOLOGY

3.1 Status at Marmara Sea

“Various researchs on marines reveals a dreadful picture. According to these results life has diminished 40 % for last twenty years. The number of red sea bream, comber, plaice and turbot decreased, lobster almost became extinct” (<http://www.su-dunyasi.com.tr>, June 20, 2006).

Table 3.1 : The comparison of the Marmara Sea dimension with the other seas that has connections directly or indirectly (Akkaya, 2004)

Region	Area (km ²)	Share of Marmara	Volume	Share of Marmara
World Seas	361 x 10 ⁶	0,00003	137 x10 ⁹	0,000004
Atlantic Ocean	106 x10 ⁶	0,0001	402 x10 ⁶	0,00001
Mediterranean	2,5 x 10 ⁶	0,004	39x10 ⁵	0,001
Black Sea	423 x 10 ³	0,03	537 x10 ³	0,01
Marmara Sea	11.5x10 ³	-	6x10 ³	-

As can be seen from Table 3.1, Marmara Sea has 1000 times lower capacity than Mediterranean with respect to size which is unit and effective for evaluating of a sea as receiving environment for waste and hundred times lower than Black Sea. Another specification which is as important as size in evaluating of a basin as a receiving environment is renewal capacity of water. Marmara has also very restricted hydrological structure in this aspect (Akkaya, 2004). Having wide surface area may make Marmara Sea vulnerable to atmospheric precipitation (Achman et al, 1993). Large volume of Marmara Sea and long hydraulic period in which water spend in sea indicates the fact

that pollutants can remain in this environment for long times and especially for pollutants having biological contamination characteristics this situation can cause significant negative ecological consequences (METU Marine Science, 2000).

Having 11 350 km² area and 3378 km³ volume Marmara Sea has an inland sea characteristics which all located inside Türkiye. Topographical and hydrographical characteristics of this sea play an important role on dynamics and pollution of it. One of the two important water route which connects Marmara Sea to Aegean and Black Sea is Strait of Istanbul and the other is Strait of Çanakkale. Banks on both ends of Strait of Istanbul has controlling effects on hydrodynamics of strait and consequently of Marmara Sea. Being longer and wider Strait of Çanakkale brings less restriction compared to Strait of Istanbul. Maximum length of Marmara Sea (Gelibolu – İzmit) is 276 km and maximum width is 76 km and coastal length is 927 km.

As can be seen from Figure 3.1, dissolved oxygen content which should be 4.5 – 5 mg / liter for fish to continue living and measured as 8 mg / liter at 25 meter depth in 1970, has gradually decreased and became 2,5 at 25 meter depth. This value is 2 mg / liter in İzmit and Bandırma Bay, 3 mg / liter in Erdek and Gemlik, 3.5 mg / liter in Kumkapı and Bostancı” (<http://www.su-dunyasi.com.tr>, June 20, 2006).

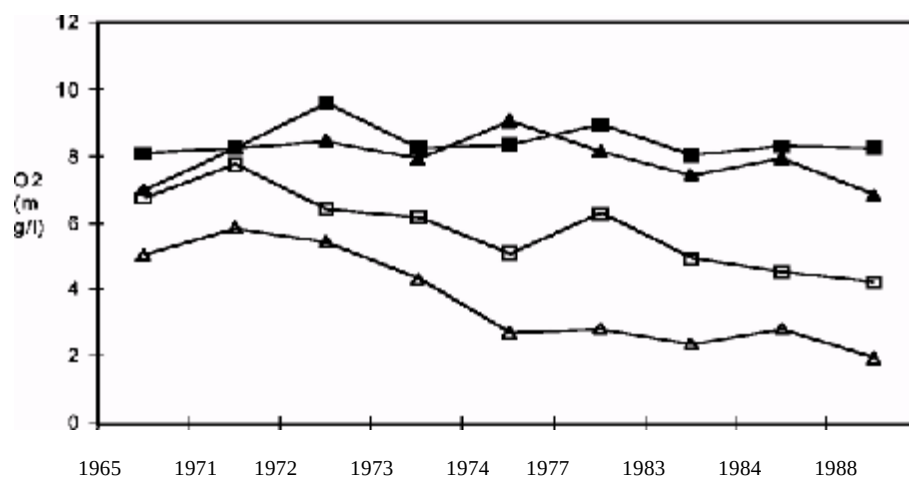


Figure 3.1 : Decreasing dissolved oxygen concentration at Marmara Sea between 1968-1988 years (Akkaya, 2004).

Oil contamination survey results performed in water column for every ten meter in Black Sea, Strait of Istanbul and Marmara Sea are given in the following Table 3.2. This findings shows that oil contamination in Marmara Sea is higher than Strait of Istanbul (Akkaya, 2004).

Tablo-3.2 : Oil pollution analyses results

Area	Black Sea(*) (µg/l)	Strait of Istanbul(*)		Strait of Çanakkale (**)		Marmara Sea(*) (µg/l)
		Inlet (µg/l)	Outlet (µg/l)	Inlet (µg/l)	Outlet (µg/l)	
Measurement of year 1996	1.49-33.9,	1.35-85.7	1.43-92.8	154.76	76.30	0.18-60.3
Measurement of year 1997	0.57-44.6	0.96-43.13	0.86-88.3	429.59	539.10	0.31-180.3

(*) : Akkaya, 2004.

(**) : Güven&İlgar, 2002.

Values for PAH measurement in 1987 indicates that average value for Marmara is 1,15 µg/l while PAH values for Black Sea outlet of Strait of Istanbul is 0,65 µg/l and 0,59 µg/l alongside the Strait. It increases to 1,47 µg/l for triangular region between Marmara Outlet of Strait of Istanbul, Büyükçekmece and Yalova. These values indicates that intensive harbour activities such as mooring, loading and unloading creates significant oil pollution and current contamination does not originate totally from Black Sea (Akkaya, 2004).

“In another investigation, the maximum oil pollution in mussels was found at Çanakkale station (exit of the strait) as 28.36 µg/g (wet weight) in May 2002 and in its entrance at Gelibolu in June 2001 and May 2002 as 17.11µg/g and 17.26 µg/g, respectively” (Güven et al, 2003, 89).

3.2 Status The Black Sea

Our approach hinges on the principle that the Black Sea and Turkish Straits should not be treated solely as a “transportation corridor”, but rather as a very sensitive “biological corridor”. The Black Sea, which covers an area of 424.000 km² is ranked second only to the Aral Sea in terms of the significant environmental threat that it currently faces. Only 7% of Black Sea, which is 37 times larger than the Marmara Sea and one fifth that of the Mediterranean Sea, contains living creatures. That is why 110 fish species living in the Black Sea are declared “under protection”. At 200 meters below sea level on the Black Sea, there is no water composition or salinity, and the temperature is constant. In simple terms, there is no life below 200 meters. The waters of the Black Sea can only be completely renewed in 7 years. However, this renewal is due solely to the existence of the Strait of Istanbul. The Strait of Çanakkale is thus the vital artery for the Black Sea’ (Türkiye Çevre Vakfı, 1999).

‘Marine pollution has reached significant levels in Black Sea in recent years. Sewage from major parts of 17 countries which constitute continental Europa, 3 capital and 160 million people discharge into Black Sea. Danube, Don, Dnieper which are major rivers in Europa flows into Black Sea and these rivers carries significant amount of contamination. “Mnemiopsis Leiydi” which resembles jellyfish and comes from American coast within waste water of a vessel during mid 1980’s has increased biological damage in Black Sea during last 30 years. Because this species surrounded whole Black Sea in a short time and fed by eggs of small fishes and by fish larvas. Accounting about 900 million tonnes in time it caused decrease in fish species such as anchovy and horse mackerel. Today the amount of mnemiopsis has reduced but its effect still continues. (...)

Sea bottom at northwest of Black Sea has turned into dark and arid desert. Organic substances from dead phytoplankton and dissolved oxygen content have decreased significantly. This situation resulted in death of living creatures such as shrimp, crab, mussel and oyster. Total number of plant and living creature between 150 – 200 meter water basin in Black Sea reduced to 1200. this figure is about 7000 in Mediterranean. Black Sea is faced with a significant threat because of hydrogen sulfur production at bottom due to structure, decay as a result of drifting of some creatures after death to bottom and resultant methane gas. Since streams flow counterclockwise in Black Sea, pollution hits coasts. Renewal time which is seven years in Black Sea is three months in Marmara Sea and 80 – 100 years in Mediterranean. According to scientific studies, every year the area without oxygen enlarges, bacteria level increases, living creatures die in Black Sea and consequently the sea is drowning' (<http://www.su-dunyasi.com.tr>, June 20, 2006).

The deepest point in Black Sea is 2212 meter and average depth is 1300 meter. Total volume is 537 thousand km³. 87 – 90 % of this volume is covered by deep water with no oxygen. It is in brackish/hard water characteristics. The area of Black Sea Basin together with rivers in Europa and Asia is five times larger than the sea and is approximately 2.2 million km².

Since Black Sea is in a heavily raining region, thus less evaporating, and since land based soft water inlets are too much, the excess in surface waters flows towards Marmara Sea through Strait of Istanbul. It accepts some salty water from Mediterranean through Strait as a reverse stream from bottom.

Significant contamination transported by Danube River is a fact alongside oil pollution in Black Sea. The biggest rivers that flow into Black Sea spans northwest shelf between Crimea and Romania: the annual flow volume of Danube River is between 4000 – 9000 m³. Flow rates of Dniester and Dnieper is about one third of Danube. The flow rates of rivers in Turkiye is between 100 – 600 m³/sn average (....)

The organic material load of Danube River which has the highest contamination load and forms significant part of 2.2 million km² wide drainage area of Black Sea has increased 10 fold since 1950.

According to the results of investigations that Balkan Temporary Task Force (BTF) which is formed by United Nations Environment Program (UNEP) and Human Settlements Centers (HABITAT), dioxyn, mercury, PCB and dichloride contamination around Paneva, Kraguyeva, Novi Sad and Bor regions in Serbia has reached the level that “requires emergency intervention”. According to the findings of report given to UN at September 30, it is highlighted in the data taken from 12 stations that post war chemical contamination has “increased significantly” and that this contamination partially affects Black Sea (Hungary Water Pollution Institute Manager Dr. Peter Literathy, 22 September 1999, Training meeting in Istanbul, TAEK). With this report it was put forward that many industrial institution bombed during civil war in Yugoslavia and contaminations leaking from them continue to pollute Danube and Black Sea.

On the other hand, Danube which is the biggest contamination source among the rivers flowing into Black Sea not only contaminates Black Sea but also contaminates Marmara through Strait of Istanbul.

In researches performed by Alaettin Bahekapılı it was found that AKM and CHL-A contents decrease until they reach Turkiye but these values are as high as 20.000 m3/s and they creates large mass inputs for Marmara Sea through upper channel flow of strait. Additionally the loads that Black Sea discharge through upper flow channel of Istanbul Strait are estimated as 20 tonnes of organic nitrogen, 20 tonnes of phosphor, 300 tonnes of silica per day. 150 million tonnes of solid materials are transported to Black Sea by erosion; only 17 tonnes are from Turkiye. 75 % of land based pollutants comes from Danube River, % 20 comes from rivers in Commonwealth of Independent States and 5 % of remaining comes from rivers in Turkiye and Bulgaria (Bahekapılı, Ev & Kltr Dergisi 3)

a) Depth

Deep smooth bottom covers more than 60 % on sea bottom of Black Sea. The highest depth is about 2300 m and average depth was determined as 1240 m (Kıdeyş et al, 2000, 239-330)

b) Wind

Wind is one of the parameters that is effective in dispersion and transport of pollution after an accident. Wind condition in Black Sea during winter is variable. Dominant wind direction is north-northeast in western Black Sea while southern winds is dominant on east of bassin. Strong winds usually blow from northwest. Summer in which air temperature exhibits more monotonic distribution is generally mild. Air temperature drops suddenly in October and November and reaches minimum in January and February. The variation of air temperature in North-South direction during winter is very high. Daily average temperature may drop as low as 8°C in Southern Black Sea while it can drop below zero especially Northern regions between Danube River and Crimean Peninsula (Kıdeyş et al, 2000, 239-330).

c) Water Regime

The condition and hydrochemical structure of total water body in Black Sea depends on elements of hydrological balance since it is a wide and closed basin surrounded by land. The characteristics of surface waters are controlled mainly by inlet of fresh water and exchange in shallow Strait of Istanbul is limited. On the other hand Mediterranean water that enters Strait of Istanbul has impact on ventilation of deep waters and halocline's structure.

d) Circulation Characteristics

“A cyclonic rim current (named as “Main Black Sea current” or “Rim Current”) harmonic in basin scale is main feature of general circulation of Black Sea (Figure 3.2 (...)) It is known that the circulation which is formed by the effects of nonuniform surface currents creates with the help of circulation resulting from wind significantly wide surface currents” (Kıdeyş et al, 2000, 239-330).

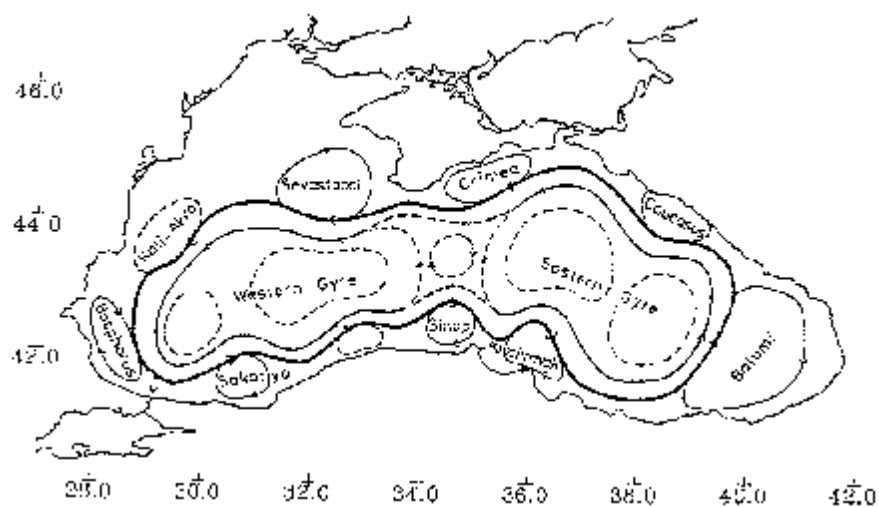


Figure 3.2 : Basic view for general circulation of upper layer (Kıdeyş et al, 2000, 239-330).

e) Phytoplankton and zooplankton Variations

When data which is available in Hydrobiological Research Institute where the list of general phytoplankton species are kept and scientific studies carried in different periods are taken into consideration, it can be seen that phytoplankton abundance is minimum in December and maximum in May and October and biomass values reaches maximum in these months (Figure 3.3).

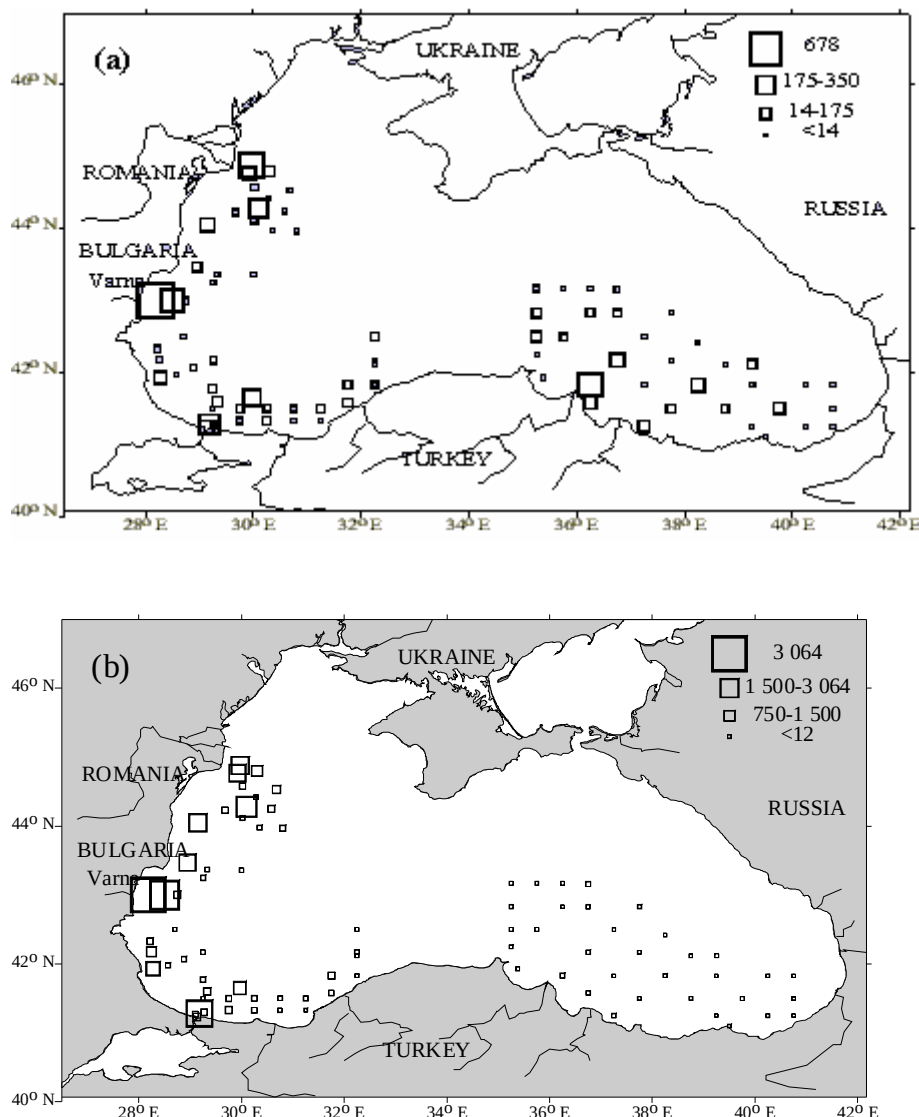


Figure-3.3 : Phytoplankton (a) widthness (*10³ cells l⁻¹) and (b) biomass (µg l⁻¹) distribution on March-April 1995 (Eker et al, 1999)

Few nutrition zooplankton species were either totally extinct or significantly reduced in various sampling points in Black Sea within one or two decade. As for a few species adopted atrophic conditions successfully is either newly appear or increase in number. Meanwhile biomass of nutrition zooplankton continuously changes in years. However an inverse relation is found between long term variations of shallow regions in west and deep regions in east. 90 % of fishes ovulating during summer time lay eggs on shallow waters of Black Sea (especially regions such as northeast region where has largest continental shelf).

Like ovulating mature individuals, other individuals such as egg and larva that in beginning period of their life are affected from negative ecological factors and cease to exist at the beginning. The concentration of fish larvae has considerably decreased with respect to former years or the larva concentration at other seas during last few decades. It was shown that this situation is mainly a consequence of insufficient nutrition of larva. One of the major changes in ihtiyoplankton is the relocation of ovulating region of anchovy (*Engraulis encrasicolus*) from northwest of Black Sea to southeast especially. The negative effects of harmful aquatic microorganisms introduced by uncontrolled ballast water discharge was observed as excessive *Mnemiopsis* increase in northwest continental shelf at the end of 1980's and at the beginning of 1990's.

3.3 Turkish Straits System

The region which is composed of Straits of Istanbul and Çanakkale and Marmara Sea and known as Turkish Strait System is faced with significant risks for life, property and environment because of intensive national and international sea traffic. This region is an area that is 305 km in total and is composed of Strait of Istanbul, Strait of Çanakkale and Marmara Sea, which has very risky structure due to stable geographical, morphological and oceanographic structure. There are factors such as current with speed up to 7 – 8 miles per hour, wind, shoal and islands that requires difficult maneuvers and effect secure navigation.

Many scientific studies were carried out on Marmara Sea, Strait System and Black Sea Region to designate the ecological status and determine the amount and effects of contamination that was created because of oil or other contamination sources.

‘In Marmara Sea where life concentrates on upper layer, the less salty waters coming from Black Sea through Strait and the chemicals it carries has great importance for the ecosystem in Marmara Sea.

Because the volume of waters coming from Black Sea renews the waters in the upper part of Marmara Sea twice a year (Özsoy et. al, 1988, 1993; Beşiktepe et. al., 1994). (...) Calculations made by findings about available nutrition elements roughly exhibit annual nitrogen and phosphor budget. Because the water flow between adjacent seas is as floating as chemical components of dual layer current system in Marmara Sea and Straits. (....)

Oceanographic studies carried out along Strait and on Ahırkapı discharge region supports that in Strait of Istanbul -Marmara Sea intersection region where land based wastes are discharged to lower layer currents, chemical loads from Black Sea affects primarily upper layer ecosystem in northeast Marmara' (Özsoy et. al., 1994).

a) Physical Characteristics of Turkish Straits

Straits of Çanakkale and Istanbul which has variable and strong current systems with narrow, sharp turns and sandbanks are one of the toughest water passages. "Strait of Istanbul which is 31 km long, and has 0.7 km minimum, 3.5 km maximum and 1.6 km average width and Strait of Çanakkale which is 68 km long and having a 70 degrees sharp turn at Nara Cape which the narrowest point is 1.3 km wide, alongside characteristics resulting from natural conditions such as strong current, wind and intensive fog, are the narrowest water passage when compared to other straits in the world" (Türkiye Çevre Vakfı, 1999).

Strait of Istanbul which is one of the most crowded water passages has 4 times more traffic than Panama Channel and 3 times than Suez Channel. Strait of Istanbul is a marine area within the line which connects Anadolu Lighthouse and Türkeli Lighthouse at north and the line connecting Ahırkapı Lighthouse to Kadıköy İnciburnu Mendirek Lighthouse at south, and being a narrow, steep and deep region is the basic physical characteristics of Strait (Başar, 2003).

“Although the average depth of Strait of Istanbul is 35.8 m, occasionally deep cavities up to 110 m can be seen. There is a threshold with 34 m depth, 3 km inside from southern inlet. The most shallow point of Strait is offshore of Üsküdar with 15 m and the deepest point is offshore of Kandilli with 110 m. There are many banks in respect to morphological structure” (Başar, 2003).

b) Climate Characteristic of Straits of Istanbul

Southern winds blowing from Mediterranean and Aegean and Black Sea winds blowing from northeast are known as dominant winds in Istanbul Region. Due to the dry hot air coming from Red Sea in July and August offshore breeze occurs. Sometimes winds blowing from south carry warm and more humid air to the region. When winds are strong enough, they cause huge waves in Marmara shore and entrance of Strait. Winds from south usually blow in winter. Winds blowing from land towards sea don't create waves. Winds blowing from offshore towards land (northwest, north, northeast winds) are strong and dangerous. These type of winds don't have an important effect on southern inlet of Strait. Since Black Sea (413.500 km²) is larger than Marmara (11.000 km²) and breeze is strong, typical land-sea light winds are observed. Dominant winds in Strait is in direction of north, northeast, northwest and southwest.(....)

Direction and intensity of upper current in Strait of Istanbul is given in Table 3.3 as a function of wind direction and intensity (Başar, 2003)

Tablo 3.3: Direction of wind- upstream along The Strait of Istanbul (Başar, 2003)

Area	Wind		Upper current		Wind		Upper current	
	Direction	Intensity	Direction	Intensity	Direction	Intensity	Direction	Intensity
Rumeli Feneri Anadolu Feneri	southwester	4	South	0.4	northeast	1	South	0.7
Büyükdere Umuryeri	southwester	2	South	0.8	northwest	2	South	1.3
Akıntı Burnu Vaniköy	southwester	3-4	South	0.4	north northeast	4-5	South	2.2
Kuruçeşme Çengelköy	-	-	South	1.0	north northeast	3-4	South	2.4
Dolmabahçe Üsküdar	southwester	2	South	1.2	northeast east	6-7	South	4.1
Sarayburnu Üsküdar	South wind southwester	8	South	0.2	-	-	South	2.2

The differences in sea level arise from tide, wind and water balance of Black Sea. The slope of Strait between Kavak and Çubuklu is approximately 2 cm for 9 km and it is 17 cm for 8 km between Çubuklu and Üsküdar. These slopes are 0.22 and 2.12 cm/km on average and when 31 km long strait is considered it is 1.12 cm/km on the average. Difference in elevation between Black Sea and Marmara Sea is 35 cm.” (Başar, 2003).

c) Currents of Turkish Straits

“The physical structure of the Strait of Istanbul is more dangerous in terms of navigation than the Strait of Çanakkale. The Strait of Istanbul is one of the rare locations in the world with respect to its natural features, which include narrow and sharp curvatures, and four different currents. The depth of the upper current that flows from the Black Sea to the Marmara Sea varies from 5-10 meters to 35-40 meters. Similarly, the waters of the Aegean Sea which are more dense, rise up from the bottom of the Strait of Istanbul towards the Black Sea.

It takes seven years for this current to entirely renew the waters of the Black Sea. As the circulation of currents continue the upper current hits capes along the coast and bounces back on its journey from the Black Sea to the Marmara Sea. This reversal is observed in almost every small cove on the Strait of Istanbul. Two of these currents are especially dangerous. One of these originates at Bebek cove and connects to the main current at Aşiyan cape. The other starts at İstinye, retreats at Balta Limanı and reconnects with the main current at the shallow lighthouse near Yeniköy. When the current is strong, ships that lose control run aground almost without exception. The current heads toward to the Black Sea with the help of southerly winds, but the flow is so irregular that it impacts counter-flowing currents, creating whirlpools and so called “mirrors” at several points in the Strait. Such movement is not typically observed in other seas and straits. Therefore, no one knows the impacts of currents on ships better than captains who have many years of experience in the region. A small mistake by an inexperienced captain who has never crossed Strait of Istanbul before may cause a tragedy with irreversible impacts.

This change between the Black Sea and Mediterranean Sea discussed above is a result of surface currents from the Strait of Istanbul to the Marmara Sea and deep currents flowing in the opposite direction. Surface currents are intensified by wind. Winds out of the South may decrease its speed; any sometimes they may reverse it. Northerly winds increase its speed. In addition, the specific width of the Strait of Istanbul and sharpness of coastline also could play a role in determining the speed of current. A strong current at deeper layers of the strait called “the canal” carries the saltier water of the Marmara Sea to the Black Sea. The intermediate layer between these two currents varies from 18-50 meters at the Marmara and Black Sea entrances, respectively”(Türkiye Çevre Vakfı, 1999).

“Surface current speed at north of Straits are 0.5-0.75 lower compared to that of at south. The depth of interface is approximately 10-15 m at southern threshold and around 40-45 m at northern threshold at normal sea and air conditions.

The boundary between upper layer which less salty Black Sea waters flow towards Marmara Sea and lower layer which salty Mediterranean waters flow towards Black Sea is at 18 m depth on Marmara side and at 50 m depth on Black Sea side. Current speed is 1.22 m/s at Kuzguncuk. The speed of bottom current generally increases as depth increases while surface current decreases with increasing depth. Upper current travels both shore from north to west and accelerate on capes”(Başar, 2003).

In some surveys carried out in 1998 and 1999 geometric and bathymetric variations, for example the effects of shore structures such small bays and capes within Strait of Istanbul was reviewed (Figure 3.5-5). It is known that such effects adversely affects navigation of passing vessels and frequently causes accidents. At points where current excessively accelerates or reverse, these unexpected sudden changes complicates the maneuver of vessels as a result of either delays in command or inertia of floating body and causes accidents.

Especially in coves such as Beşiktaş, Çengelköy, Bebek, Yeniköy, Paşabahçe, Beykoz, Umuryeri and Büyükdere vortexes and reverse currents occurs (Figure 3.4) and the speed of current changes time to time locally and as a result of peripheral forcings due to widening and narrowing in cross section of Strait.

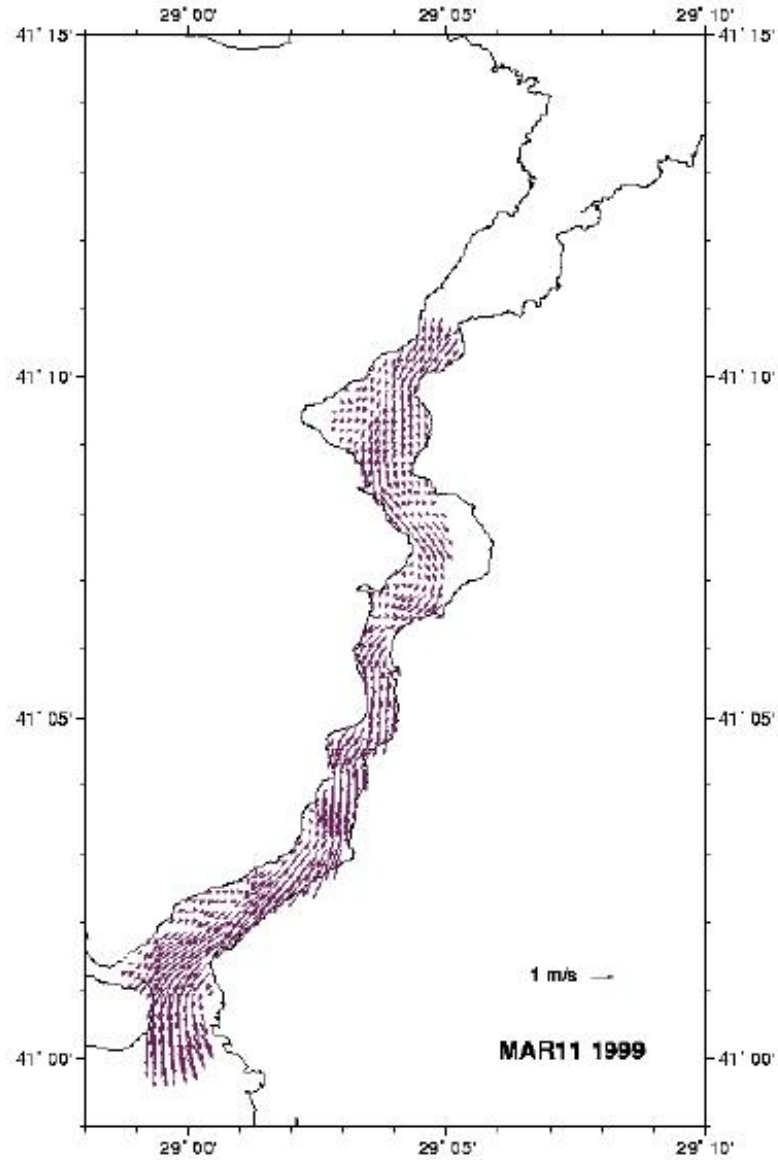


Figure 3.4 : Current result depend on detailed ADCP current measure in Strait of Istanbul in 11 March 1999.

The questions such as at which rate the waste water of Istanbul that discharged into bottom waters of Strait of Istanbul mixes with waters in upper layers, whether they reach surface waters or not, at which rate they return to Marmara Sea by means of upper layer currents have been the subjects which is discussed time to time. The most reliable estimates on this issue is the calculations that are based on average salt and water balance given in Figure 3.4 and they have been used as basic criteria for design of waste water system. Nevertheless concerns have always been risen in public and related groups about the possibility that waste given to the environment through diffuser systems commenced in Ahırkapı and defined with different density and source characteristics compared to marine environment may show different behavior than obtained from these estimates. Therefore in addition to the usual monitoring studies, activities aiming direct measurement using tracking materials (paint) and acoustic methods was also performed. In direct measurements including “extreme” conditions in which lower and upper currents are blocked, it was demonstrated that waste water given in Ahırkapı discharge arrives Black Sea with diluted concentrations projected for lower current and the amount of waste water which reach surface is low even for quite constraining conditions (Beşiktepe, 2000).

The simulation of oil distribution after tanker accident was done in Strait of Istanbul. In this study, current is one of the most important effect of oil spill was modeled by using Princeton Ocean Model (POM). Results from this model were used as current data base for General NOAA Oil Modelling Environment (GNOMETM). Then, GNOME was run for 4 stations where statiscally most accidents area.

In all these simulations, at the beginning of each simulation 1000 metric tones of oil discharges at sea. Low (3knot) and high (15 knot) wind speeds were used. And also time distribution of model was run 10, 20, 40 and 60 minutes. Than these areas were identified as a risk.

As a result of simulations, most effective areas for preventive action for oil spill were found. Anadolukavağı, Tarabya, Çengelköy and Sarayburnu were identified to be under more risks”(Başar, 2003).

3.4 The Marmara Sea

a) Marmara Sea Hydrography and Circulation

Marmara Sea includes two water bodies which one of them is Black Sea based and the other is Mediterranean based and separated by a density (saltness) interface (halocline) at approximately 25 meter depth. In an environment in which sharp density stratification in haloklin hinders oxygen inlet to lower layer from surface, there is a balance between oxygen production that was caused by precipitation of biogenic based particulate from surface to lower layer and Mediterranean waters which enters from Strait of Çanakkale and is rich in oxygen. Although there are suboxic conditions for waters under haloklin in Marmara which is renewed by continuous water inlet from Strait of Çanakkale (average renewal time is 6-7 years) (Ünlüata and Özsoy, 1986, Özsoy et al., 1986, 1988), anoxic conditions similar to Black Sea have not been developed. On the other hand in recent years eutrophication and consequently hypoxia have been observed in some coasts and bays which have limited interaction with open sea (Baştürk et al., 1986, 1988, 1990). The renewal periods for upper layer waters of Marmara Sea which is fed by waters from Black Sea is approximately in the order of few months.

Salty waters of Mediterranean entering from Strait of Çanakkale decline depending on density difference between salty waters of Mediterranean and lower waters of Marmara Sea and stratification of Marmara Sea waters, along topography until the depth that they reach balance (Beşiktepe et al., 1994).

Balance depth is also determined by interference turbulence rate of bottom tuft which is in the form of density current and eat and saltiness that was imported from environment (Beşiktepe et al., 1993). In cases where density difference is high waters may sink until bottom; otherwise they may reach balance at medium depths. As a result of this condition, anomalies in saltiness is observed in two depths of which one is at 200-300 m depth and the other is near to bottom and extends from west to east like a tongue.

i) Winter

Aegean waters entering through Strait of Çanakkale reaches maximum in winter and they are havier than basin waters. Therefore waters entering in winter immediately sink in bottom on west and can be distinguished by low temperature and high saltiness. These waters sinking in winter time fills the cavity in the far east of the basin. The maximum of saltiness declines from west to east and resides at 50 – 200 meters depths. At medium depths there are less salty waters in the shape of wedge.

The saltiness of upper layer waters increase up to 26 in winter time especially towards Strait of Çanakkale because of strong winds. The saltiness is low near Strait of Istanbul because of the effect of Black Sea.

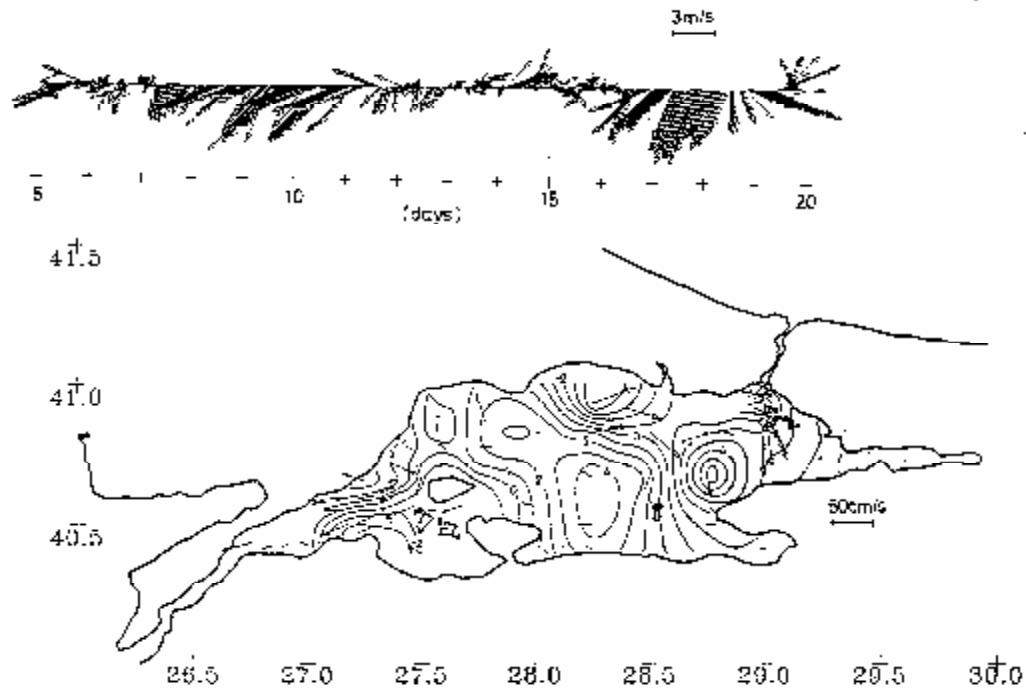


Figure 3.5: ADCP current vector drawn on dynamicaltitude anomalies, March 1992

Surface currents which were measured by ADCP drawn on dynamic altitude anomalies are given in Figure 3.5. High velocity jet originating from Strait of Istanbul is quite clear. In addition the waters of Marmara Sea enter in Strait of Çanakkale also have high velocities. The wind vectors given above Figure 3.5 indicates the existence of winds which is in various strength during navigation but usually from north. These northern winds strengthen the jet of Strait of Istanbul and also causes small scale loops (≈ 25 km.) within the basin. The jet carrying Black Sea waters entering basin through Strait of Istanbul flows in the direction of south-west first, then creates a current in basin dimension rotating clockwise by turning to north-west.

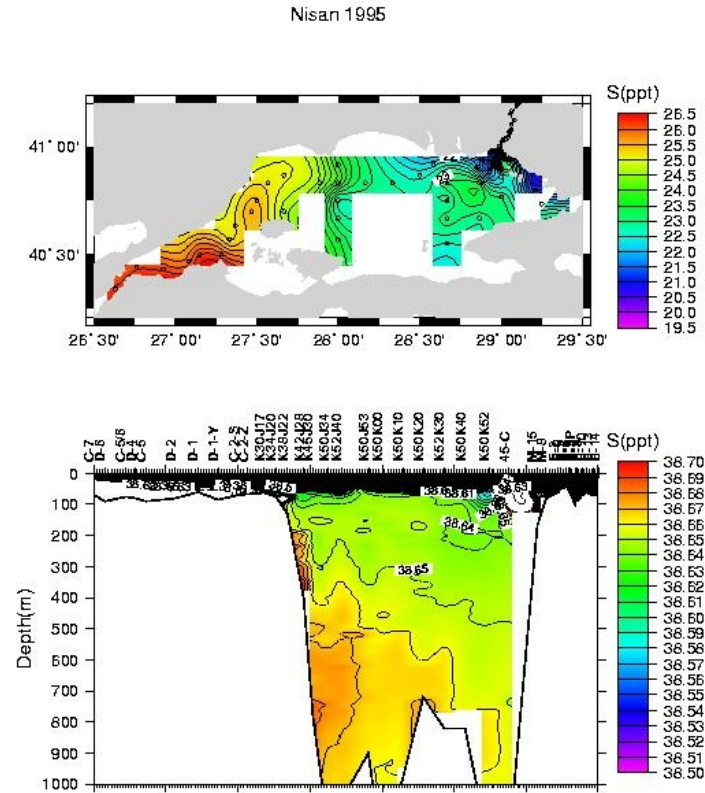


Figure 3.6: Salinity distribution at the Marmara Sea in April 1995 (a) 5 meters deep and (b) along the Marmara Sea west-east axis direction

It can clearly be seen from satellite images that the jet from Strait of Istanbul moves first to south and turns to west hitting Bozburun Peninsula (Beşiktepe et al., 1994; Özsoy et al., 2000).

ii) Spring

The waters sinking in bottom in winter time move towards east in the following months (Figure 3.6). As a result of this the cavity in the west is filled with new waters and the cavity in the middle as well is filled and even runs over the cavity in the east. Although the Aegean waters entering into basin in the spring is still heavy, they are not as heavy as enough to sink in bottom and may sink in up to 700-800 meters. Waters with high salt content which has sunk till bottom can easily be distinguished.

Surface water hydrography and currents in spring is similar to that of in winter. This is because the strong winds still affects the region at the beginning of spring and the average flow of waters from Strait of Istanbul can not reach maximum. Black Sea waters coming from Strait of Istanbul enters as a jet and then creates a clockwise current in the dimension of basin.

iii) Summer

Hot and salty Aegean water that enter basin in summer can only sink in certain depths. Aegean waters entering Marmara Sea through Strait of Çanakkale are observed as high saltness cells between 150 m – 500 m. the waters entering Marmara Sea separate into two and some of them mix with basin through south of Marmara Island and the other part travels from north of it as in other seasons. These waters of which density has changed due to mixing with adjacent waters sink in different depths. Saltness anomalies observed in deepest waters has been caused by waters sunk in winter.

Surface saltness is less than that of in winter and spring and varies between 20 and 22. However it increases up to 24 in shallow region and bays at south of Marmara Island. Current system that can be deduced from saltness distribution indicates that a clockwise circulation extending basin dimension is dominant. The jet from Strait of Istanbul travels in south-west direction and reaches first to the southern

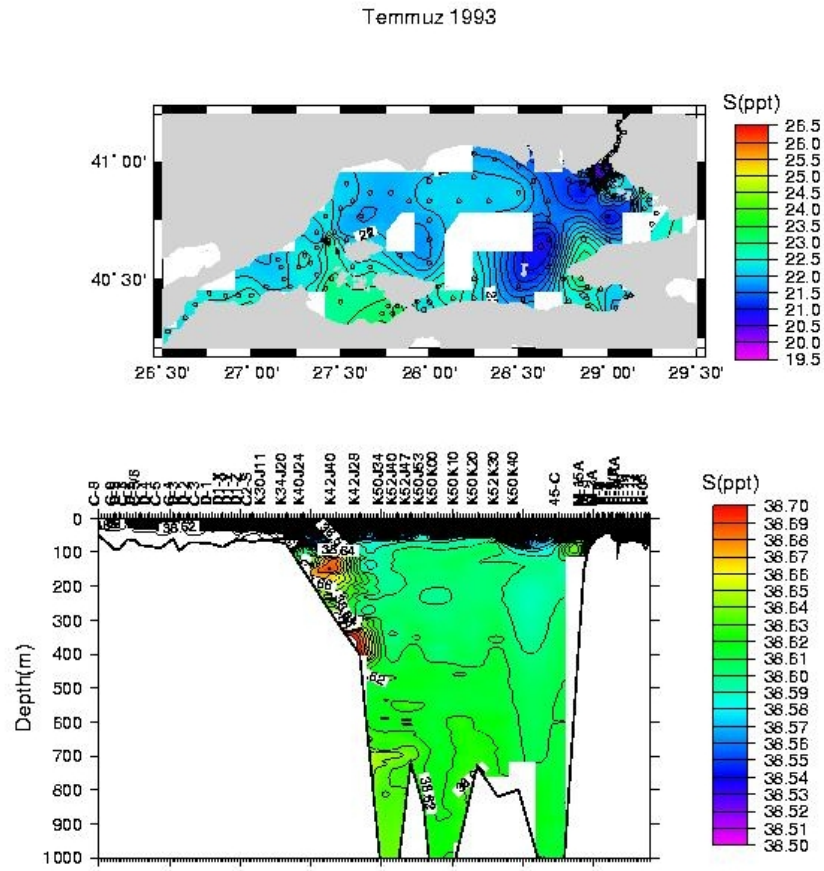


Figure 3.7: Salinity distribution at the Marmara Sea in July 1993 (a) 5 meters deep and (b) along the Marmara Sea west-east axis direction.

coast of basin. Then it turns towards north-west direction. It is seen that this general current doesn't affect bays at south.

iv) *Autumn*

The density of waters coming from Aegean Sea in autumn is lower than that of lower layer (Figure 3.7 – lower panel). Therefore the waters entering in this season don't sink in depths and creates saltiness maxima here by entering basin through just beneath the halocline. The waters entering in this level has advanced until the center of basin and occupied a wide area.

The waters sinking in bottom in winter have filled the central cavity in Marmara Sea. Waters in medium depths and that hasn't been renewed by waters coming from Çanakkale remains as less salty.

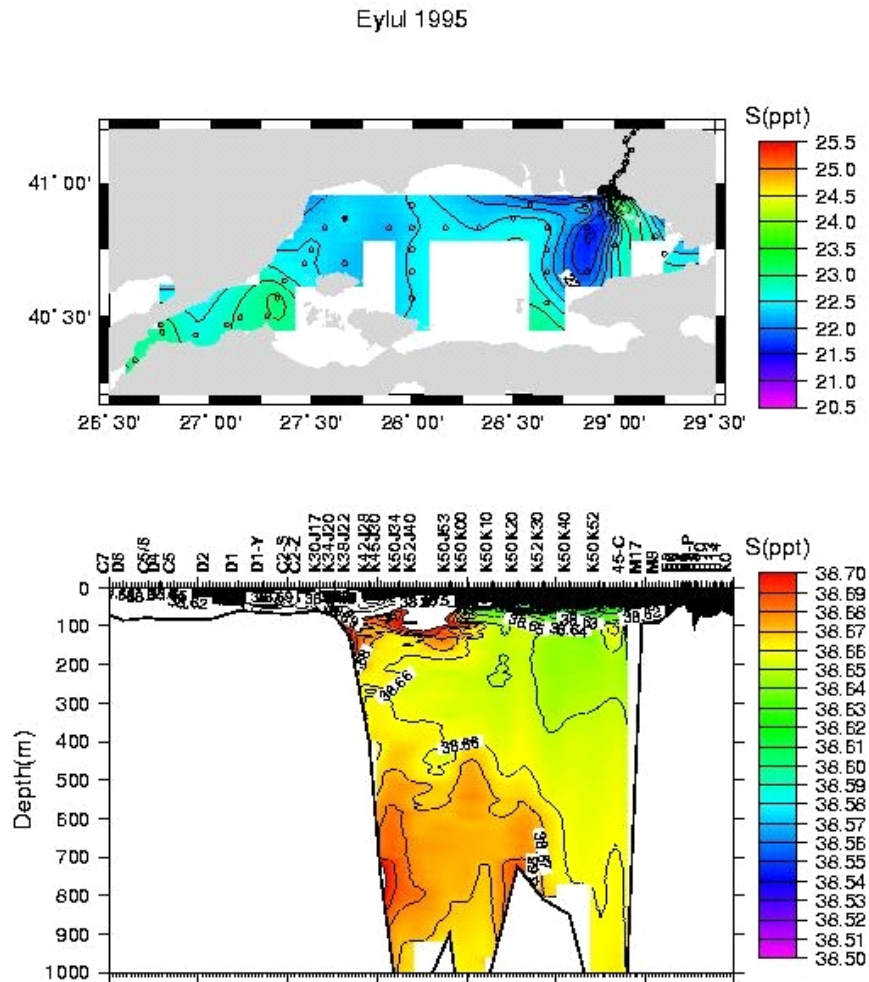


Figure 3.8 : Salinity distribution at the Marmara Sea in September 1995 (a) 5 meters deep and (b) along the Marmara Sea west-east axis direction

The wind tension forcing in autumn is quite irregular and its effect is observed as fast variations in circulation. For example while tide in Strait of Istanbul advances through south in a calm manner in September 1995 (Figure 3.8), wind tension affecting surface circulation causes eddies and change in known tide circulation in case in October 1992 showing a contrary situation.

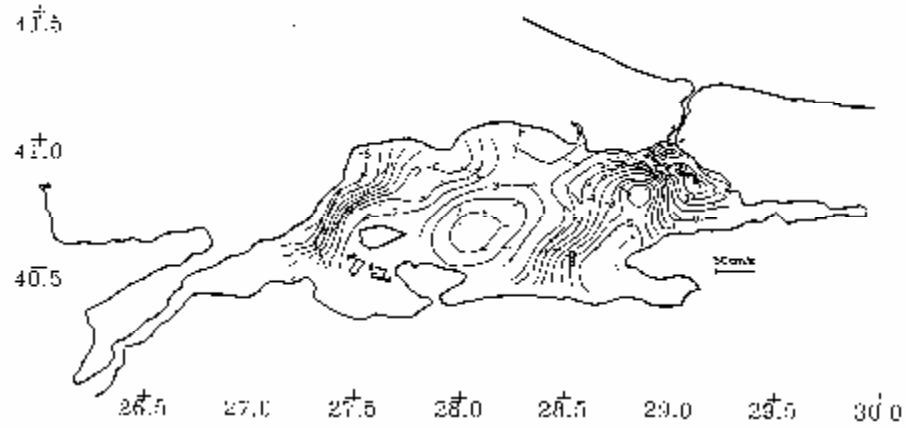


Figure 3.9 : Dynamics high anomalies drawn on ADCP current vectors, October 1992

The circulation of and lower waters of Marmara Sea which has been derived from measurements that has been carried between March 1992 and October 1999 and analyzed here can be outlined as Figure 3.10.

The circulation of surface waters in Marmara Sea (Figure 3.10 – upper panel) can be defined as a clockwise circulation of the jet from Strait of Istanbul within the basin. These general structure may change due to variations in wind and/or in the amount of water from Black Sea.

The Aegean waters coming from Strait of Çanakkale reach the cavity in the west of basin through undersea canyon which is an extension of Strait of Çanakkale. Then it creates a current in depths of basin towards east (Figure 3.10 – lower panel). However in summer time some of the waters from Aegean Sea turns east and follows a different route and affects the south part of basin.

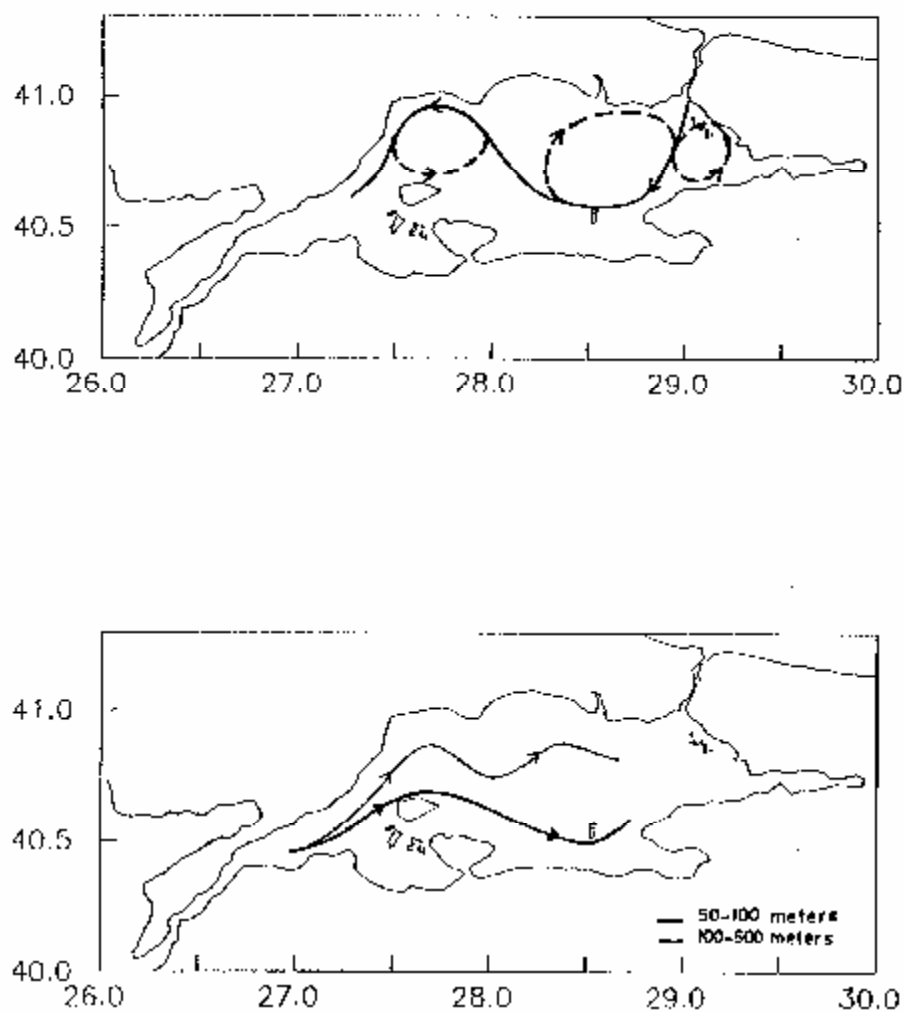


Figure 3.10 : Currents of Marmara Sea.

3.5 Marine Pollution

GESAMP (United Nations Group of Experts on the Scientific Aspects of Marine Pollution), defines marine pollution as follows:

“Introduction of man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities

including fishing, impairment of quality for use of sea-water, and reduction of amenities” (Yönsel, 2000).

Marine pollution occurs as a result of overstraining self cleaning ability of seas by pollutants. Pollution developed in world seas due to reasons such as human activities, marine traffic and industrial developments reaches levels which jeopardize human health, by moving through food chain. The productivity and sustainability of biological life in marines depends on oxygen in water, the amount of heat and water temperature. Flora and fauna in marine are directly affected by any change in this field. Marine surface;

- by exchange of oxygen between atmosphere and sea, enables extra oxygen in atmosphere to dissolve in water and transport by streams to different depths of sea.
- provides continuity of life in the sea if it is clear and clean since sunlight necessary for photosynthesis of zooplankton and phytoplankton penetrates to deep.
- protects ecological equilibrium by enabling contact with atmosphere and sunlight necessary for maintaining water temperature if it is not polluted

Factors that cause marine pollution can be analyzed in 3 groups; namely air, sea and land based factors. Air based pollution originates from introduction of toxic gases and molecules as acid rains due to air pollution coming from industry and domiciles and spillage of oily wastes of aircrafts on high seas.

Sea based pollution is mainly the pollution from vessels. We may list the pollutants as follows when we wish to mention about marine pollution caused by vessel traffic:

- Petroleum products
- Radioactive materials
- Toxic liquid materials transported as mass.
- Harmful materials which can be transported as parcel or in mobile tanks, containers, wagon or lorry tanks,

- Bilge, ballast and tank washing waters of ships
- Ship based residential waste waters (waters from toilet, bath and kitchen)

Spillage of ship loads, either knowingly or unwillingly, directly affects marine environment. The most significant effect of shipping occurs as a result of accidents. “Every year approximately 3 million tones of petroleum spill into sea. One of the sources of ship based (from vessels) pollution comes from disposal of oil waters and tank washing” (Taşdemir, 2002). Another pollution source which originates from ships is spillage during shipment of petroleum and petroleum products which accounts 60 % of world marine transportation. As a result of these spillages, the oxygen exchange between sea and atmosphere are hindered and this affects natural life and nutrition mechanisms in sea bottom, consequently causes mass death.

In addition to the effects on marine environment caused by petroleum spillage, significant damages occur on costs depending on wave strength.

The sea water carried by vessels during navigation up to 30 % of its capacity in order to maintain stability and navigation safety is identified as ballast water. Releasing this ballast waters into water on offshore instead of handing over port facilities also causes additional ecological problems and pollution, can be harmful to sea species in area and significantly affects fishing sector. Millions of organisms having different characteristics are moved to seas having different oceanographic features by this operation aiming ship safety.

Although it is not legal, cleaning of ballast tanks, drainage of bilge into sea, pouring waste into water in passenger vessels also contributes to the deterioration of the problems. The amount of petroleum products released to sea due to such processes which unbelievable reaches up to approximately to 1 million tones/year rises concerns in whole world. (Bishop, 1983)

Pollution of sea from land originates from sewage waters released into sea without purification, wastes from paper, chemistry, petroleum, steel etc. industries released into marine environment which may include toxic metals and toxic pesticides that also may cause biological accumulation in creatures (as in Eastern Mediterennean). Similarly in the vicinity of energy plants built in sea shore pollution may arise due to continuous release of cooling water, sea water gradually increases and characteristics of environment is changed.

Pollution in marine environment by such land based wastes causes aerobic bacteria activities to increase in marine environment and decrease in oxygen content due to excessive reproduction of new species or species currently available. Such pollutions results eutrophication (death of living creatures and anoxia due to increase in nutrition salts such as nitrogen and phosphor) in semi closed or inherently stagnant marine structures. İzmit Bay and Köyceğiz Lake can be given as examples for such pollutions (Yönsel, 2000).

Today living sources which is assume that newer come to end gradually give out, and their natural reproducability capacity decreases steadily. In the meantime significant decreases in number and amount of species are observed in Istanbul, Strait of Çanakkale and Marmara Sea which are the biological corridors that is used by sea creatures as migration route and is forced by passage of petroleum tankers.

3.6 Oil and Oil Characteristics

3.6.1 Oil Description

Petroleum is a form of bitumen composed principally of hydrocarbons and existing in the gaseous or liquid state in its natural reservoir. The word petroleum originates from the Latin *petra* (rock) and *oleum* (oil). Petroleum is composed almost entirely of the elements hydrogen and carbon, in the ratio of about 1.85 hydrogen

atoms to one carbon atom. The minor elements sulfur, nitrogen and oxygen constitute less than 3 percent of most petroleum. (Hunt, 1979)

Petroleum in its natural form is of limited use, because of this petroleum is refined and refining products is used as a widespread. The refining process results in products from the original crude oil with different hydrocarbon compositions (Figure 3.11).

Hydrocarbons are classified as below:

1) Saturated Hydrocarbon (Parafin=Alkan=Saturate)

- a) Straight Chain (normal alkan)
- b) Branched (Iso alkan)
- c) Ring (cyclo alkan)

2) Unsaturated Hydrocarbons

- a) Alkenler (Olefinler)
- b) Alkinler (Asetilenler)
- c) Aromatikler (Arenler)

“Hydrocarbons that result from petroleum products such as oil, gasoline, or diesel fuel are among the most commonly occurring and widely distributed contaminants in the environment. Volatile hydrocarbons are the lighter fraction of the hydrocarbons and, together with fuel oxygenates, are most often released from crude oil and liquid petroleum products produced from crude oil.

“From 1970 to 1999, primary energy production of the world grew by 76% (Energy Information Administration, 2001), with fossil fuels (crude oil, natural gas, and coal) accounting for ~85% of all energy produced worldwide. World crude oil production reached a record 68 million barrels (bbl) per day ($1.08 \times 10^{10} \text{Ld}^{-1}$) in 2000” (Watts&Teel, 2003).

3.6.2 Petroleum Chemical Composition

A refinery crude oil into useful products by multistep processes that may include distillation, extraction, catalytic or thermal cracking, and final hydrotreating to remove unwanted compounds. When the petroleum was refined petroleum products is became in below (Table 3.4). For example, gasoline is one of the lightest fractions and contains the lighter hydrocarbons (C_4 - C_8 range, where n in C_n refers to the number of carbon atoms in the hydrocarbon chain), whereas bunker fuel (fuel for ships that may be a mixture of two or more of the distillate cuts) has a higher boiling point and contains mostly the heavier components ($>C_{14}$)

Table 3.4 : Petroleum products and uses(Watts&Teel, 2003).

Petroleum Products	Percentage (%)
Motor gasoline	45.7
Still gas refinery fuel	4.4
Kerosene-type jet fuel	10.3
Special naphthas (Solvents, paint thinner)	0.3
Kerosene (Illumination, space heating, cooking, tractor fuel)	0.4
Distillate fuel (Home heating oil, diesel fuel, refinery fuel, industrial fuel)	22.5
Petrochemical feedstocks (Alcohols, resins, ethers, fibers, medicines, cosmetics)	2.9
Residual fuel oil (Boiler fuel, refinery fuel, Bunker fuel, wood preservative)	4.7
Lubricants (Lubricating oils, greases, transmission oils, household oils, textile spindle oils)	1.2
Asphalt and road oil (paving, roofing, waterproofing)	3.2
Petroleum coke (Carbon electrodes, fuel coke, electric switches)	4.6
Miscellaneous products (Absorber oil, white machinery oils, cutting oils, candymaking, banking oils, technical oils, medicinal salves, ointments, petroleum jelly, acetic acid, sulfuric acid, fertilizers)	0.3
Waxes (Used for: fruits, vegetables, candy, chewing gum, candles, matches, crayons, pencils, sealing wax, canning wax)	0.2
Liquid refinery gases (Petrochemical feedstocks, space heating, cooking, synthetic rubber)	4.6
Aviation gasoline	0.2

3.6.3 Crude Oil

Crude oil within the Earth is of biological origin, formed when the remains of once-living organisms were buried and subjected to heat and pressure over million of years. The composition of the petroleum formed in a given geologic deposit depends chiefly on the nature of the original organic material and the basin's thermal history (Tissot&Welte, 1984). Hydrocarbons are a complex mixture of over 1000 compounds with different physical and chemical properties.

Crude oil sometimes contains mineral salts, as well as trace metals such as nickel, vanadium, and chromium. In general, hydrocarbons compounds include the saturates, olefins, aromatics, and polar compounds (Oil in the Sea Committee [OSC], 2002).

The main groups of compounds in crude oils are saturated hydrocarbons (such as normal and branched alkanes and cycloalkanes that contain no double bonds), aromatic hydrocarbons, resins and asphaltenes (higher molecular weight polycyclic compounds containing nitrogen, sulfur, and oxygen (NSO), and organometallic compounds (Tissot&Welte, 1984). Unsaturated hydrocarbons (nonaromatic, hydrocarbons containing one or more double or triple bonds), such as olefins, essentially are absent. Most producible crude oils contain, on average, 30-35 % each of n-and isoalkanes, cycloalkanes, and aromatics (Table 3.5) although there can be a large variation in the actual composition for individual crudes. The most abundant hydrocarbons in crude oil are in the light fraction (<or ~C15). For example, in most crude oils the abundance of n-alkanes decreases beyond n-decane. In the aromatic fraction, benzene, toluene, and other low molecular weight alkylbenzenes are abundant (Tissot&Welte, 1984).

Table 3.5: Average composition of hydrocarbons in normal producible crude oils (% by weight of hydrocarbon)(total samples-517)

Compound Group	%
n-+isoalkanes	33.3
Cycloalkanes	31.9
Aromatics	34.5
Saturated: aromatics	2.8
Alkanes : saturates	0.49

After Tissot and Welte (1984)

“Crude oil occurs within the Earth and is a complex mixture of natural compounds composed largely of hydrocarbons containing only hydrogen and carbon atoms. The minor elements of sulfur, nitrogen and oxygen constitute less than 3% of most petroleum (Hunt., 1996). Releases to the environment occur during the production, transport, processing, storage, use and disposal of these hydrocarbons. The petroleum industry classifies oil naturally occurring in a liquid phase as either conventional oil or nonconventional oil. Conventional oils can be explored and produced by conventional primary and secondary recovery techniques, whereas nonconventional oils, such as heavy oils, tar, sands, and synthetic oils, are more difficult to extract from the host rock” (Tissot&Welte, 1984).

‘Among the classes of compounds in crude oil, the alkanes, cycloalkanes, and aromatic fractions contain compounds that are volatile. The NSO compounds, resins and asphaltenes, and organometallic compounds are nonvolatile and, in general, are less mobile in the environment. (...) Benzene, toluene, xylenes, ethylbenzene, isopropyl benzene, naphthalene, methyl and dimethyl-naphthalenes (Figure-6) are among the most important volatile aromatic hydrocarbons, because they are widely used and, once released into the environment, their mobility and toxicity make them a significant environmental threat (Merian&Zander, 1982). The occurrence of these compounds in the environment is almost exclusively anthropogenic, with the exception of natural hydrocarbon seeps.

The saturate group of compounds in various crude oils consists primarily of alkanes, which are composed of hydrogen and carbon with the maximum number of hydrogen atoms around each carbon. Thus, the term “saturate” is used because the carbons are saturated with hydrogen. The saturate group also includes cycloalkanes, which are compounds made up of the same carbon and hydrogen constituents, but with the carbon atoms bonded to each other in rings. Higher-molecular-weight saturate compounds are often referred to as “waxes”.

Olefins, or unsaturated compounds, are those that contain fewer hydrogen atoms than the maximum possible. Olefins have at least one carbon-to-carbon double bond, which displaces two hydrogen atoms. Significant amounts of olefins are found only in refined products’ (NRC, 1985).

Aromatic compounds include at least one benzene ring. Benzene rings are very stable, and therefore persistent in the environment, and can have toxic effects on organisms. The more volatile monoaromatic (single-ring) compounds found in crude oil are often referred to as BTEX, or benzene, toluene, ethylbenzene, and xylene (NRC, 1985).

Aromatic hydrocarbons may account for about 1 to 20 percent of the total hydrocarbons in crude oil. Benzene and alkyl benzenes with one or two methyl or ethyl groups (toluene, xylenes, ethylbenzene), the BTEX compounds, may be present at a concentration of several percent in light crude oil, but more typically are present at concentrations of 1.000 to 10.000 mg/kg. Usually, toluene is the most abundant of the BTEX compounds, followed by benzene or one of the three xylene isomers. More highly alkylated benzenes usually are present at low concentrations in crude oils.

Polycyclic aromatic (multiple-ring) hydrocarbons (PAH, also called polynuclear aromatic hydrocarbons, PNA) consist of at least two benzene rings. A typical crude oil may contain 0.2 percent to more than 7 percent total PAH.

Some related aromatic compounds (not technically hydrocarbons because they may contain within their structure many elements such as NSO) are detected with the same analytical techniques and often occur with true polycyclic aromatic hydrocarbons. Thus, these compounds are often grouped with, and discussed as, PAH. includes these compounds that have the most serious environmental effects of the compounds in crude oil. PAH in the environment are derived largely from combustion of oil and coal, but are also produced by the burning of wood, forest fires, and a variety of other combustion sources.

The abundance of aromatic hydrocarbons in petroleum usually decreases with increasing molecular weight. In most cases, one-ring (benzene) through three-ring (phenanthrene) aromatic hydrocarbons and related heterocyclic aromatic hydrocarbons, such as dibenzothiophene, account for at least 90 percent of the aromatic hydrocarbons that can be resolved in crude petroleum by conventional analytical methods. Four-through six-ring PAH, some of which are known mammalian carcinogens, usually are present at low or trace concentrations in crude oils. The PAH in petroleum often contain one or more methyl, ethyl or occasionally higher alkyl substituents on one or more aromatic carbons. As a general rule, these alkylated PAH are more abundant than the parent compounds in petroleum (Watts R.J., & Teel A.L., 2003). Classified hydrokarbons and theirs structure are shown Figure 3.11 (after Tissot&Welte, 1984).

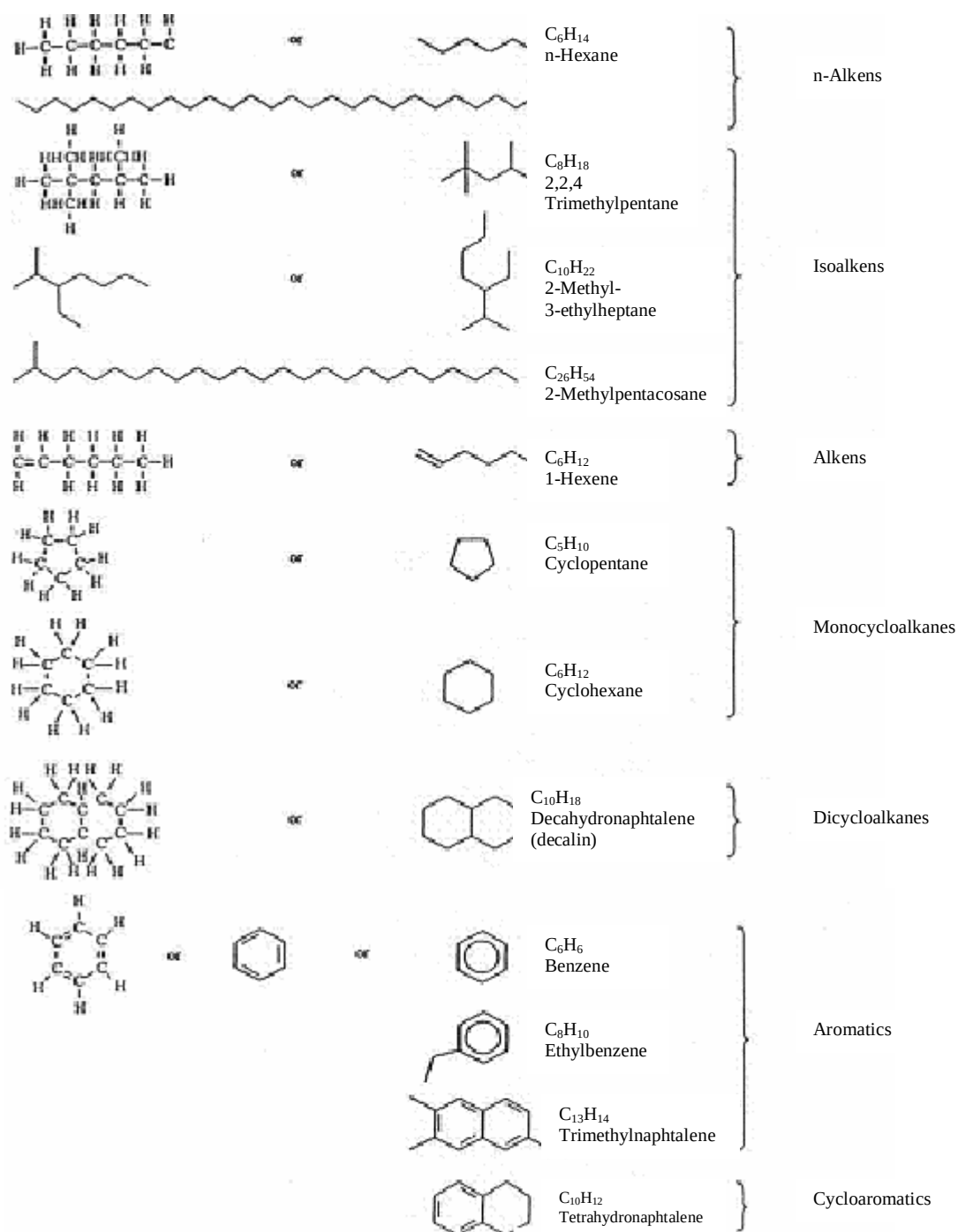


Figure 3.11 : A sample of volatile hydrocarbons present in crude oil for the major compound classes, n-alkanes, isoalkanes, n-alkenes, cycloalkanes, aromatics, and cycloaromatics (after Tissot&Welte, 1984)

3.6.4 Oil Effects

“The petroleum industry has two main components, exploration/recovery and refinement/delivery. Crude oil is delivered to refineries and refined products are delivered to consumers through a large transportation network that includes tankers, barges, pipelines, and railroads. This transportation network links suppliers and producers across the world. (...) The global and complex nature of petroleum industry means that every environmental compartment (air, land, water, biota) and all nations are affected by petroleum spills and waste products.

Concentrated releases of compounds to the environment generally are associated with product mishandling and accidents during storage and transportation. (...) An oil tanker spill at sea can result in the rapid dispersal of large amounts of product. This is point pollution resources and in the case of a tanker spill, the point release can result in a serious regional problem such as the spill of the Exxon Valdez that spilled oil that spread 750 km from the original spill site and impacted 1750 km of shoreline” (Wolfe et al., 1994).

The effects of oil on waterfowl are easy to observe and waterfowl probably are the most affected species. Waterfowl seem irresistibly attracted to oil slicks either through their normal feeding habits or the characteristic vapor of the oil. They subsequently dive into the oil and their feathers become oil soaked. Waterfowl exposed to oil have a probability of survival which is quite small. They subsequently perish due to exhaustion, starvation, and exposure.

Nonpoint sources can cause compounds to be dispersed throughout the hydrosphere, which can complicate efforts to evaluate the effect of oil spills. Current sampling and analytic techniques allow for the detection of volatile organic compounds (VOCs) at low concentrations ($0.1 \mu\text{g L}^{-1}$ and less). (...) The importance of VOCs at low concentrations in ambient water is unclear.

If these low concentrations are the result of plumes emanating from point sources, then concentrations could possibly increase with time.

Oil may damage or kill fish or shellfish in a number of manners. It can directly kill them by coating their epithelial surfaces, by contact poisoning due to small concentrations of the highly toxic hydrocarbons present in oil, and by exposure to water-soluble toxic components of oil at some time and distance from the oil spill. Other nonlethal effects of oil on fish or shellfish include the tainting of their flesh, which renders them unfit for consumption, physical fouling, and repellent effects which may affect the propagation of the species.

Oil, if present in sufficient quantities over an extended period of time, is toxic to aquatic plants. It is suspected that one of the low-level, long-term effects to the marine ecosystem is damage to the microscopic marine plants. Free oil and emulsions may coat and destroy algae. The coated organisms may agglomerate with suspended solids and settle to the bottom. An eventual oily coating of the bottom will destroy bottom-dwelling forms and disrupt spawning areas.

“The impact of an oil spill on the ecology can run the full spectrum of maximal to minimal depending on such factors as the species involved, the amount of oil spilled, local tide, wind, and current conditions, the toxicity of the oil, the solubility of the oil, the biodegradability of the oil, the oil’s volatility and density, and the carcinogenicity of the oil.

Many other organisms (invertebrates) inhabit the marine environment. These organisms play an important part in nutrient cycles and food chains. Cases of oil being the causative agent of widespread destruction of benthic fauna have been recorded. Oil changes the composition of bacteria present in water so that bacterial forms using petroleum or any of its derivatives as a nutrient source will predominate. Whether this is beneficial or harmful to the environment is difficult to say except that it does offset a longstanding ecological balance.

There are other effects of oil on the marine environment which are generally applicable to all forms of aquatic life. For instance, the exposure of organisms to sublethal amounts of oil results in their reduced resistance to infection and other stresses. Apart from the particular reaction of any given species to a given amount of a specific oil, there will always be more-sensitive juvenile forms of that species due to the presence of the oil.

Heavy coatings of free oil on the surface of the water may interfere with the natural processes of reaeration and photosynthesis. There has not been, however, any significant environmental effect on the exchange of oxygen and carbon dioxide between the water and the air. There has also been some speculation about the effect of oil on the behavior of marine organisms. While this is possible, there has been no direct evidence to account for the disruption of behavior of any marine organism” (Porricelli et al, 1971)

3.6.5 Effects of Oil in Marine Ecology

Oil spillage in marines is originated from vessels, oil explorations on sea bottom and production activities, spillage as a result of accidents and oil transported through rivers. When oil spills, spreads on marine environment, the light and easily evaporating components quickly disperse into atmosphere and tarry components which are heavier than water remains in water. Oil/water suspensions in various thickness are formed on surface which is choppy due to turbulence, wave and stream activities. Oil beads breaking off surface partially dissolves in water while parts which are heavy for dissolution keep their spherical shapes and precipitates towards bottom. These spheres which collide and increase in weight during precipitation are known as “tar-ball”. Tar-ball spheres cover sand or sediment by moving through deep streams and reach coast as a result of wave, cause pollution of marine vehicles (Figure 3.12).

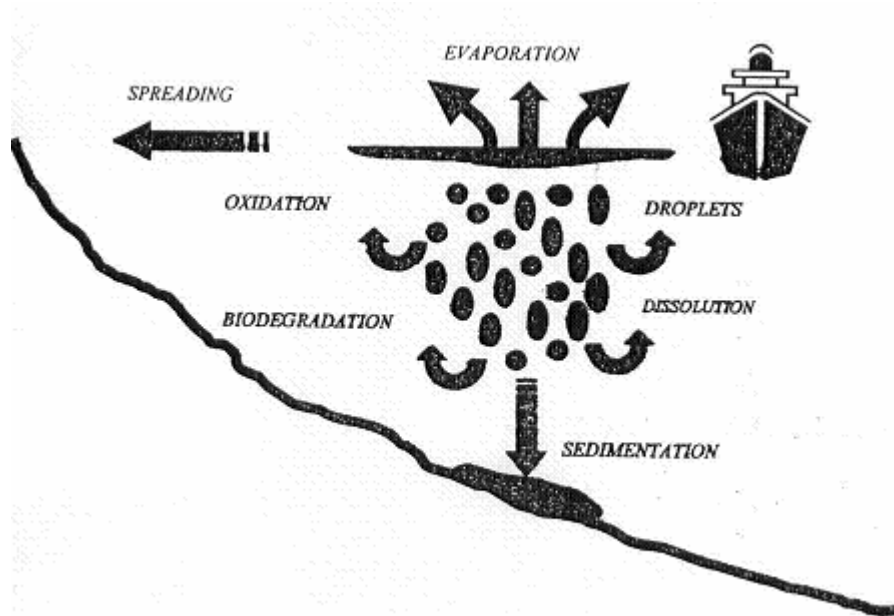


Figure 3.12 : The oil distribution in the sea

Oil causing decrease in dissolved oxygen content in water by hindering gas exchange between sea and atmosphere, also obstruct photosynthesis which is curicial for life in marine environment.

Oil pollution which adheres to wings of sea birds and causes swimming and dipper birds to loose flying capability and resistance to cold also hinders water to be used for recreation purposes.

Oil pollution which is very common in marine environment and resultant components affect more or less all organisms in ecosystems. Resistance of various creatures living in marine environment against oil products is different. Oil products has lethal toxic effects on sea creatures and causes accumulation on tissue and cells and causes changes on physiological activities.

“Species such as scorpion, lobster and shrimps which live buried on sea bottom are the most vulnerable ones to oil pollution. These are effected by 1-10 ppm oil concentration. Double shelfishes such as mussel and fish species are sensitive to 5-50 ppm and sea plants are sensitive to 10-100 ppm. Lethal effects on larva and young orgnism fertiles can be observed at lower concentrations such as 0.1-1 ppm.

Since oil hydrocarbon solutions are at 10-100 ppb level, their effects on living creatures occurs as abnormal behaviors in normal nutrition and reproduction schemes” (Turkiye Environment Foundation, 1999)

Consumption of fish and other fishery products that was contaminated by oil products is undesirable since some of the components which forms crude oil include substances known as causing cancer for mammals and humans (Yönsel, 2000).

A lot of technics are improved in order to pollution measure in the sea area. One of them is A Marine Oil Pollution Index (MOPI). MOPI is presented to characterize the hydrocarbon burdens of marine tissues or sediments. The index incorporates the ratios of unresolved to resolved components, even *n*-alkanes to odd *n*-alkanes, and branched hydrocarbons to *n*-alkanes, plus the total recoverable aliphatic and aromatic hydrocarbon concentrations from gas chromatographic analysis, to yield a single value that can be used to compare the relative magnitude of oil contamination in a series of tissue or sediment samples. (Payne et al, 2004)

Ünlü et al studied on TPAO tankship accident which was occurred in Tuzla Gulf on February 1997. The aim of this study was to measure the petroleum pollution in the sea water. Water samples had taken from sediments and shells. By this accident 214.3tons petroleum was dispersed to sea and 250 gallons of it was burned. The area which was effected from accident has measured and the results were; pollution in the sea was mostly; 33.2 mg/l, in the sediment 423.0 mg/kg and in the shells were; 2067mg/g.

The pollution rate was observed constantly till one year. After one year than accident the second measurement had done. There couldn't be found any data on environment that could be related by accident (Ünlü et al, 2000).

3.7 Turkish Straits and Marine Accidents

“On March 24, 1989, the tanker Exxon Valdez, en route from Valdez, Alaska, to Los Angeles, California ran aground on Bling Reef in Prince William Sound, Alaska. The vessel was travelling outside normal shipping lanes in an attempt to avoid ice. Within six hours of the grounding, the Exxon Valdez spilled approximately 10.9 million gallons (37 kilotonnes) of its 53 million gallon cargo (156 kilotonnes) of North Slope crude oil. The oil would eventually impact more than 1.100 miles (2400km) of noncontinuous coastline in Alaska.” (Poricelli et al, 1971).

The rising risk of accidental oil spills from oil transport is clearly visible from the number of tankers passing the narrow Strait of Istanbul which can have a dramatic consequences for population and for environment case of major accidents.

Tankers are the single largest source of oil pollution from ships. Sources of the tanker oil pollution problems are shown in Figure 3.13.

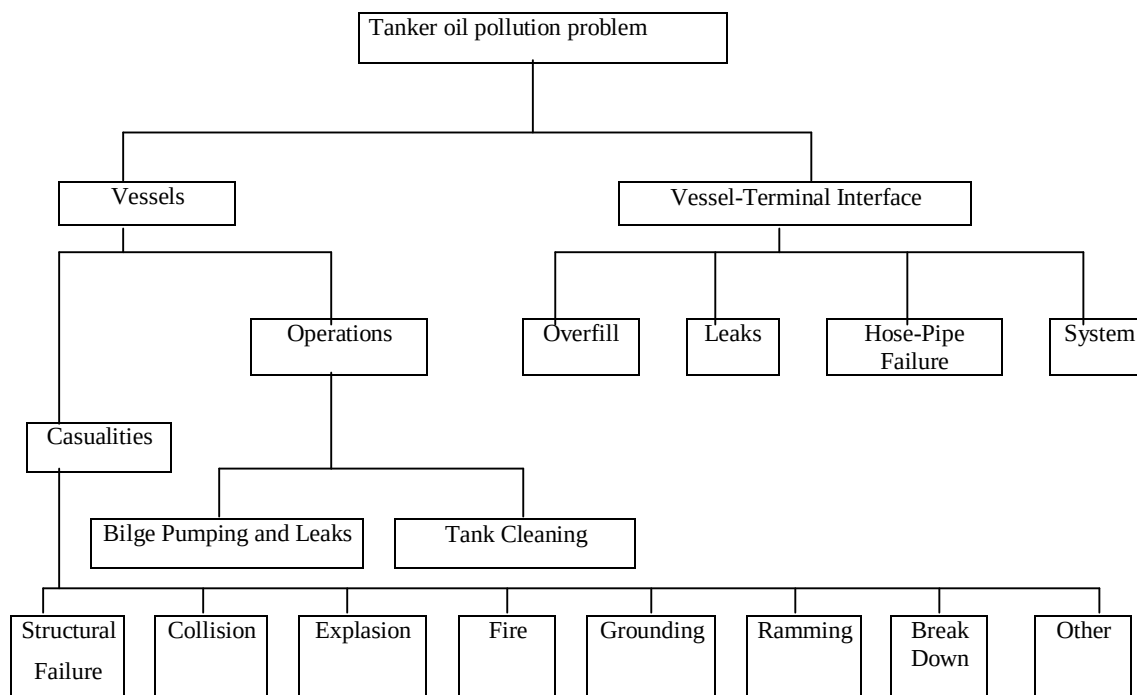


Figure 3.13 : Sources of tanker pollution problems, (Poricelli et al, 1971)

3.7.1 Statistics and Assessments About Turkish Straits

Turkish Straits, which are among the narrowest waterways of the world, also have risky geographical structures. The passage of ships, which was limited to 4.500 during the Montreux Convention of 1936, increased to 60.000 in recent years. While length of ships were 20 metres at most as of 1936, today ships of 400 metres pass through the Straits. The tonnage of ships increased to 400 thousand tons from 10 to 15 thousand tons (http://www.su-dunyasi.com.tr/mart2004_8/denizkirliligi.htm, April 23, 2006).

“Within a glimpse of passages through the Strait of Istanbul in 2003, it is found out that;

- more than 96% of ships are greater than 500 GRT,
- guide captain is being used at the percentage of 45%,
- 97% of them represent route plans,
- they carry 135 millions of dangerous loads,
- 17% of passages are composed of tanker passages, which increased by 9,5% compared to year 2002,
- 33% of ships carry the flag of Türkiye” (Akten, 2003).

In accordance with the existing data and statistics, regarding the accidents in the Strait of Istanbul during the period of 1984-2004, it is drawn out that;

- the accidents are denser in the months of January (13%), February and March (12%), whereas they are rarer in April and October (5,1%),
- near misses happened mostly in June (13%), April and July (11,7) in a diminishing line, and least in March (5,1%),
- during the period of 1982-2003, locations in which the accidents were common, were Salıpazarı, Kızkulesi, Harem, Üsküdar, Kabataş, Karaköy, Dolmabahçe, Beşiktaş, Beylerbeyi, Sarayburnu, Çengelköy and Eminönü in the First Region with the percentage of 33,4%; Rumelihisarı, Yeniköy,

Akıntı Burnu, Kanlıca, Arnavutköy, Bebek, Baltalimanı, Anadoluhisarı, Vanıköy, Emirgan, Paşabahçe, Çubuklu, Kuruçeşme, İstinye, Fatih Bridge in the Second Region with the percentage of 27,6%; Büyükdere, Anadolu Kavağı, Umuryeri, Kireç Burnu, Dikilikaya, Beykoz, Yenimahalle Ağzı, Sarıyer, Kavak Burnu, Rumeli Kavağı, Sütlüce in the Third Region with the percentage of 16,9%; whereas the accidents were less in the Fourth Region composed of Rumeli Feneri, Istanbul and the entrance of Black Sea, with the percentage of 7,6% (Figure 3.14),



Figure 3.14 : The Strait of Istanbul

- in 2004, there were no accidents in the First Region, while the Second Region, which has the narrowest passageway, had the highest rate with the percentage of 18,8%, later Third and Fourth Region (12,5%),

- during the period of 1982-2003, accidents took place in the forms of crash (45,6%) and strands (20,4%), while in 2004 strands were observed more common as a result of VTS,
- groundings occurred mostly in Yeniköy and Umuryeri (Akten, 2004),
- during the period of 1982-2003, ships with Turkish flags were principally involved in the accidents (51,3%), while ships with American and Antilles flags involved least (4,8%); however in 2004 Russian ships and ships of Turkish Republics in Central Asia, had the most accidents (37,5%), whereas European, Americana Antilles ships had the least (12,5%),
- during the period of 1994-2003, near misses, occurred in the Second Region at most (27%), in the Third Region (24,1%) and in the First region (20,4%); while the Fourth Region had the least rate,
- during the period of 1982-2003, the accidents took place within the hours of 04:00-08:00 (12,5%), 08:00-12:00 (12,2%) at most; while the hours between 16:00-20:00 had the least (10.0%);
- in 2004 the percentage of accidents that took place between 04:00 and 08:00 increased to 87,5%,
- near misses mostly occurred between 12:00 and 16:00 (14,6%), 16:00- and 20:00 (13,9%) and least took place between 04:00 and 08:00 (6,6%),
- the accidents were rooted from humans (22,5%) and then geographical conditions and defects (12,2%),
- in 2004, the reason of 15 out of 16 accidents were unknown, whereas the reason of remained one was defect,
- during the period of 1982-2003, ships without Guide Captain mostly involved in the accidents (92,8%), while ships accepting Guide Captains were only included at the percentage of 7,2%,
- in 1994, the percentage of accidents including Guide Captains was 10,3%, however, it was diminished to 3,4% until 2003,

As the VTS was launched in 2004, the accidents were reduced by 30% (Ece, 2005).

‘The Strait faced 461 marine accidents of different types in 1953-2002 period, accounting 24% (110) for the “left-side up scheme”, 58% (269) for the “right-side up scheme” and the remaining 18% (82) for the “traffic separation schemes” respectively(....)The most important marine accident in Strait of Istanbul are shown in Table 3.6.

Table 3.6 : Major collision accidents in the Strait of Istanbul, (Akten, 2004)

<i>Date</i>	<i>Vessel Name and Flag</i>	<i>Accident Area</i>	<i>Accident type and if oil spilt</i>
14.12.1960	World Harmony (Greek)v.Peter Zoranic(Yugoslav)	Kanlıca	Collision and fire : 18.000 tons oil spilled
15.09.1964	Norborn (Norwegian)v. Wreck of Peter Zoranic	Kanlıca	Contact: fire and oil spilled
01.03.1966	Lutsk(USSR)v.Kransky Oktiabr (USSR)	Kızkulesi	Collision and fire : 1850 tons oil spilled
15.11.1979	Independientia (Romania) v. Evriali (Greek)	Haydarpaşa	Collision and fire : 94.600 tons oil spilled
09.11.1980	Nordic Faith (British) v. Stavanda(Greek)		Collision and fire
29.10.1988	Blue Star (Malta) v. Gaziantep (Turkish)	Ahırkapı	Contacted mt Gaziantep: 1000 tons ammonia spilled
25.03.1990	Jambur (Iraqi) v. Da Tung Shan (Chinese)	Sarıyer	Collision and fire : 2600 tons oil spilled
14.11.1991	Madonna Lilly (Phillipines)v.Rabunion 18 (Lebanese)	Kanlıca	Collision : 20.000 live animals drowned
13.03.1994	Nassia (Phillipines)v.(Shipbroker) (Figure...)	Sarıyer	Collision and fire : 9000 tons oil spilled; 20.000 tons oil fired.
30.12.1999	Volganef (Russian)	Ahırkapı	Collision: 1200 tons oil spilled
07.10.2002	Gotia(Greek)	Bebek	Collision and stranding: 22 tons oil spilled

Ships spend quite long time from one port to others, are exposed to various external hazards like darkness, different visibility conditions which one way or another contribute to marine casualties (Figure 3.15).

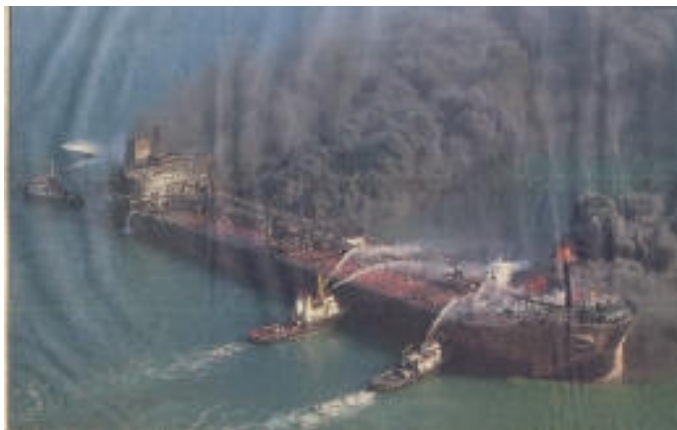


Figure 3.15 : Nassia tanker accident

The numbers of accident known to have occurred in parts of the day, i.e. in darkness and daylight, are shown in Table 3.7 according to main casualty groups' (Akten, 2004).

Table 3.7 : The Strait of Istanbul : Marine accident in darkness and daylight (Akten, 2004)

Type of accident	Darkness	Daylight	Darkness/daylight ratio
Collision	17	8	2.1
Grounding	24	8	3.0
Stranding	8	5	1.6
Fire/explosion	-	3	0.0
Others	4	5	0.8
<i>TOTAL</i>	<i>53</i>	<i>29</i>	<i>1.8</i>

The most recent collision in Strait of Çanakkale is CHINOOK tanker accident. CHINOOK tanker which is loaded with gas oil was grounding at April 22, 2005.

CHINOOK accident occurred in vicinity Kilitbahir which is the narrowest of Strait of Çanakkale (approximately 1.5 km). Reason of this accident was rudder problem and because of this CHINOOK grounding. A disaster is prevented because of double wall of tanker in rocky marine area. Turkish pilot in tanker slowed down to used all taking precaution (İstikbal, 05.03.2005).

3.7.2 Risk Reasons in Turkish Straits

Following the examination of sea accidents occurred until today; human mistakes, dense traffic, bad weather, current, fire, geography and climate, defects, bridges, energy transportation lines, structures of ships, technical incompetence, inadequate environmental route supporters, lack of obedience to the rules, insufficient communication and rescuing activities, lack of land services, less knowledge about the region, problems in implementing the Regulations on the Prevention of Collisions (COLREG 72), are drawn as the main reasons of such accidents (Ece, 2005).

Increase in the number of squadrons around Black Sea, as a result of establishment of newly independent states; inclusion of East European ships, coming from Tuna-Ren waterway, play significant role in the augmentation of traffic through the Straits.

It is known that, great part of accidents take place as the sighting distance diminishes due to snowing and raining, which increase during winter. Besides, routing with the angles of 45 degrees in Kandilli, 80 degrees in Yeniköy and 70 degrees in Umurbey, is another difficulty in navigation through the Strait of Istanbul (Ece, 2005).

In addition to the hard geography and climate of the Strait of Istanbul, streams are another factor that leads to accidents. “In general, ships coming from Black Sea to Marmara Sea involve in accidents, since upstreams follow the way from north to south. Ships also become the subject of being taken away by the following stream as the following stream, also, accelerates the speed of ship, risk of collision and strand augments. The direction and speed of winds affect the stream and increase the risk of collision.

With respect to the natural conditions in the Straits, ships have to slow down according to the speed of stream and obey the Regulation on Sea Traffic in the Straits and Marmara Sea, which puts a 10-sea miles speed limit.

Furthermore, almost 1500 local sea transportation vehicles, carrying almost 1 million people from one side of Istanbul to the other side, turn out to be a serious factor in accidents. During a simulation, in which potential risks of accidents in the Strait of Istanbul, it was drawn that, there is a positive correlation between local sea traffic and total angles of ship turnings at the collision point (Or&Kahraman, 2000).

CHAPTER FOUR

RISK ASSESSMENT

“Zero Risk” is not possible also in marine transportation like other all human activities. Richard Goss who is marine economy Professor in University of Galler said that: “Excellent security can be possible in heaven like a man. However we haven’t any chance to reach for this on the world. Because of this, we have to aim to security included acceptable risk”. This general rule is valid in marine industry and there is “risk management concept” in marine industry not only “zero risk concept”.

The most important dimension of navigation is providing security. The ships are under the risk continuously both during the navigation and in the port. This risks are clarified as risk from ships, risk from the sea, risk from the loading and risk from the crew.

The risks from ships are including that convenient for sea and road. In the same time all equipment, machine and navigation support systems should sufficient depend on international standards.

The risks from the sea can be explained that ships are included all kind of hydrographic and oceanographic conditions and marine accident. The risks from loading are related with type and characteristic of load, dangerous degree, storage, loading/unloading conditions etc. Also, the risks from crew are included which seaman training as international rules, health and shift situations.

“All type risks should be assessment for prevention marine environment from negative effects of marine incidents and accidents. The starting point for an assessment of risk at a contaminated land or spill site is understanding the pollutant linkage. This require the identification three components:

- A Source (contaminant), a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters,
- A Receptor, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body and
- A Pathway, a route or means by which a receptor can be exposed to, or affected by, a contaminant.(...)

Risk assessments are undertaken using a Tiered Approach, each tier involving an increasing level of detail and complexity. The three tiers used in CLR11 are;

I Preliminary risk assessment (Qualitative Risk Assessment);

II Generic quantitative risk assessment;

III Detailed quantitative risk assessment

Depending on the outcome of a risk assessment, it may not be necessary to continue to the next tier. Judgement may sometimes be needed as to the cost of detailed risk assessment against the benefits of remedial work. Once the risks have been assessed, and if action to reduce or control the risks is considered necessary.

Preliminary risk assessments are undertaken to develop an initial conceptual model of the site and establish whether there are potentially unacceptable risks. If potential pollutant linkages are established it may be necessary to progress to either generic quantitative risk assessment, detailed (site specific) risk assessment; or remedial work

Professional judgement plays an important part in this process, but it is important that decisions can be justified within a logical framework

Generic quantitative risk assessments are establish whether generic assessment criteria are appropriate for assessing the risks and, if so, to apply them to establish whether there are actual or potential unacceptable risks.

The purpose of detailed quantitative risk assessment is to establish site-specific data to decide whether there are unacceptable risks. It may be used as the sole method for

assessment of risks, or it may be used to refine earlier assessments using generic assessment criteria. During this stage the assessor will normally use a computer software-based tool to estimate and evaluate the risk. The key objective will be to establish, for each contaminant of concern, a concentration limit below which the presence of that contaminant in the ground does not present a risk to a receptor(s). This concentration is generally referred to as the remedial target” (Lenn, 2006)

4.1 Contingency planning

It is widely accepted that contingency planning leads to more effective and efficient response to an incident. A good plan will outline appropriate response strategies with the aim of reducing ecological, economic and social damage and subsequent compensation claims. The plan will also identify appropriate resources and expertise

The size, location and timing of an oil spill are unpredictable, so it is important that any response arrangements are flexible enough to cope with this uncertainty. In the contingency planning process a risk assessment must be carried out oil spill risks and the responses they require are usually classified according to the size of a spill, its characteristics (types of oil react differently when spilled on water) and its proximity to a response resource. In order to plan for the range of potential spill sizes, from small operational spills to worst-case scenarios, industry and governments frequently follow the concept of a 'tiered response! The concept allows for the correct level of equipment and resources to be available, within a minimum response time appropriate to the risk and for the efficient escalation of response level by calling upon supplementary resources.

“Risk assessment and response planning are the essential factors in contingency planning. Various key areas need to be considered:

Risk Assessment:

- Areas of sensitivity: These are areas that are either ecologically or commercially sensitive, for instance habitats for seabirds and other marine life; beaches and other public access areas; marinas and sea water intakes.

- Oil types: Oils spilt on water behave differently according to properties such as specific gravities and viscosity. They are also affected by temperature and other weather conditions. It is therefore essential to assess the oil types that may be encountered. Consider how they will spread and what type of equipment would be needed to collect them if spilt. This is particularly useful where a limited number of oil types are encountered.
- Local Conditions: As well as determining oil types, it is also important to look at currents, tides and typical weather conditions to assist in risk mapping. Seasonal changes should also be considered.
- Other hazards: If a spill of gasoline or a similar flammable material is a possible risk, it is imperative to assess the possibilities of a fire hazard from typical port operations such as welding or use of spark-emitting machinery.

Response Planning

- Areas for protection: After assessing areas of sensitivity as a contingency measure it is important plan how, in the event of an oil spill, these areas will be protected. Tides, current and weather conditions allowing, it may be possible to identify a “sacrificial area” into which oil could be diverted for containment and collection. This is not always an option, though, and it must be decided which areas to prioritise for protection, taking levels of sensitivity into account.
- Preventive measures: It may be appropriate to encircle a tanker with a boom during loading or discharging operations, enabling any spill to be readily contained. This is not always an option in very busy terminals or when working with highly flammable materials.
- Risk minimization measures: Heavy tanker traffic and other shipping movements will increase risks of collision or grounding so it may be advisable to ensure that laden tankers are escorted in and out of port by a response vessel such as tug, that has containment and collection equipment on board.

- Equipment stockholding : Decide on the best preparations to make in case of a spill. A central stockpile of response equipment on a self-managed basis one alternative, or a subcontracted option may be more appropriate. Factors such as finance, premises, management, manpower or a suitably skilled subcontractor must be considered. It may also be possible to purchase multifunctional equipment such as power packs and pump sets that can be used in firefighting or offloading operations. Debris collection can be handled by a skimming vessel.
- Port operations: It may seem obvious, but day to day operations-and how they will be handled in the event of a spill-must be assessed. This could mean thinking about suspending ferry services if they pass a terminal jetty, for example. The larger the port, the more consideration must be given to this matter.
- Media management/public access: The intrusion of the media or even normal public access may hamper clean-up operations and so it is vital to look thoroughly at how these elements will be controlled” (Environmental Technology and Services from the UK, Case Studies and Features, 1999).

Conceptually there are three tiers of response:

- Tier 1 arrangements are established at individual ports and oil handling facilities, and are designed to deal effectively with small operational spills.
- Tier 2 arrangements provide for the pooling of government or privately owned resources at a local level or from a wider geographical area.
- Tier 3 arrangements provide for a combined national or international response to a major oil spill that cannot be dealt with effectively under the Tier 2 arrangements.

4.2 Oil Spills- The Hidden Implications

The effects of any oil spillage are wider reaching even than the immediate and obvious impact on the environment. Amongst the hidden implications are:

Financial: The costs related to the suspension of operations and the clean-up of the pollutant.

Legal: Legal action could last for years, with the impact and cost of legal actions-in terms of prosecution, defence or third party claims.

Impact of public opinion : There may be protests, or businesses might have to suspend operations as a result of public pressure.

Impact of the media: Bad publicity could turn away current and potential investors.

Other issues: These include the costs of preventative measures to avoid further impact, for, instance power station operators may need to protect sea water intakes.

Insurance premiums will also be affected in the future.

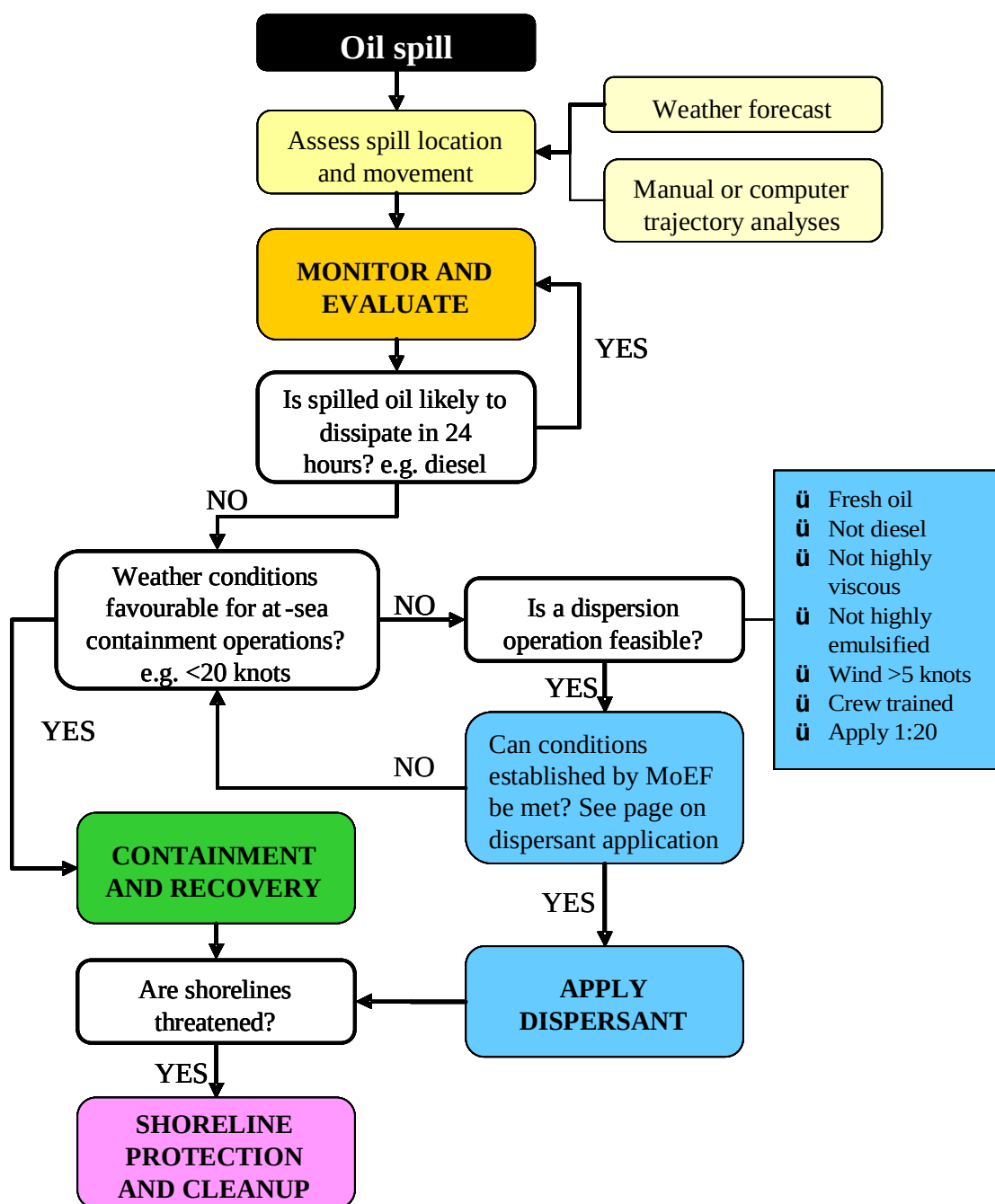


Figure 4.1 : Oil spill response plan chart

Any one of these considerations could have a serious impact on the activities of an organization. It is vital to prepare with comprehensive planning (Environmental Technology and Services from the UK, Case Studies and Features, 1999).

To estimate the number of potentially polluting wrecks, an international database of potentially polluting wrecks was developed from various national and international data sources. Extensive efforts were made to remove duplicate records and combine information to create the most comprehensive data set possible. The criteria used for inclusion of incidents in the database were:

- **Location:** marine waters, including navigable-in-fact estuarine waters;
- **Vessel types:** *non-tank vessels* of at least 400 gross tonnage (GT) holding petroleum-based oil or oil products as fuel/bunkers (and for operations); and *tank vessels* of at least 150 GT holding petroleum-based oil or oil products as cargo and fuel/bunkers (and for operations); and
- **Incident types:** groundings, collisions, structural failures, or military attacks resulting in the sinking (submergence) of the vessels. Any incidents in which the vessel was reported to have been raised, salvaged, lightered, or scrapped were excluded.

There are 1,583 tanker wrecks (including tank barges) and 6,986 non-tank vessel wrecks, for a total of 8,569 incidents in the database. The database spans the years 1890 through 2004. The majority of incidents stem from the years of World War II (1939 - 1945), with 69 percent of tanker incidents and 75 percent of non-tanker incidents (a total of 75 percent of all incidents).

“Several methods were used to develop a "high" and "low" estimate of the amount of oil likely remaining on each vessel (Michel et al, 2005). The estimates of wrecked vessels and amount of oil contained in those vessels are shown in Table 4.1 (Michel et al, 2006).

Table 4.1 : Estimates of Worldwide Oil-Containing Wrecks (Michel et al, 2006).

Vessel Type	Number Vessels	Estimated Potential Total Amount Oil	
		HIGH ESTIMATE	LOW ESTIMATE
Tank Vessels > 150 GT	1,583	14.6 million tonnes 4.3 billion gallons	1.8 million tonnes 535 million gallons
Non-Tank Vessels > 400 GT	6,986	5.8 million tonnes 1.7 billion gallons	720,000 tonnes 212 million gallons
TOTAL VESSELS	8,569	20.4 million tonnes 6 billion gallons	2.5 million tonnes 747 million gallons

Some considerations for improving the technological capabilities include:

1. The installation of emergency offloading piping and other technical design innovations of new vessels may assist with oil removal from a sunken vessel. Shiphull, piping and machinery design standards could be investigated to include simple requirements to assist in oil detection, containment, and recovery within a wreck. The increasing use of double-hull oil cargo tanks may increase the difficulty and risk of oil recovery operations. Drilling of double-hulls has been done using remote vehicles but at increased cost and risk.
2. A standard method of surveying the condition of wrecks to determine the relative risk of pollution should be developed. Such a method should consider:
 - a. Oil Survey and Sampling. The advent of non-destructive oil sensing instruments, such as gamma-ray or neutron back-scatter meters, may allow for rapid assessment of oil volumes of a wreck. The increased use of this technique may now allow for a relatively low-cost survey of potentially polluting wrecks. Techniques for direct sampling of oils should also be developed and formalized for light and very heavy oils.
 - b. Structural Condition. Further analysis of wreck corrosion rates could be used to develop a more complete understanding of the rate of hull and superstructure failure. Such data could become the basis of a wreck, risk stability model. A standard survey technique to measure and report on hull, piping and superstructure condition should be developed so that salvors and

government authorities can share common data formats. Standard guidance and some basic training on the issues of wreck surveys, risks, and recovery techniques would be useful in assuring common approaches and evaluation techniques.

- c. Quality Control. Standard procedures should be developed to document the volume of oil recovered, to estimate the remaining oil volume, and to verifying tank close-out procedures.

3. The use of heat and/or fluidizers for removing heavy oils from tanks will remain an essential technique even with the use of pump annular water injection. Improved heat exchangers and similar techniques to fluidize oil should be developed to reduce the time, cost, and reliability of heavy oil recovery operations” (Michel et al, 2006).

4.3 Risk Management in Turkish Straits

Risk management has two stage in crowded and limited water road like Turkish Straits. Primary, strait passage should be arranged in order to minimizing accidental risk and security should be increased. Secondary, ship passage should be provided to make in according to particular system. Thus marine environment and straits can be used as a functional.

Radical precautions taken through Marine Traffic Regulations which is published in 1994 and revised in 1998 for The Turkish Straits; brought about significant earnings in terms of risk analyses in the region.

The best of this precaution, Traffic Separation System is founded and closed to opposite way during the vessel which longer than 300 m. Traffic control and management practices began in the Turkish Straits thanks to Marine Traffic Regulations and monitored to the Turkish Straits with radar and video system in end of the 2003 (İstikbal, 2005).

“Simulation of oil distribution after tanker accident was done inside of scientific studies in Istanbul Strait. Current is one of the most important effect of oil spill

was modeled by using Princeton Ocean Model (POM). Results from this model were used as current data base for General NOAA Oil Modeling Environment (GNOMETM). Then, GNOME was run 4 stations where statistically most accident area.

In all these simulations, at the beginning of each simulation 1000 metric tones of oil discharges at sea. Low (3 knot) and high (15 knot) wind speeds were used. And also time distribution of oil model was run 10, 20, 40 and 60 minutes. Than these areas were identified as a risk.

With this model amount of oil and its temporal and spatial distribution can be founda by entering wind speed and directions at any area in Istanbul Strait.

As a result of simulations, most effective areas for preventive action for oil spill were found. Anadolukavağı, Tarabya, Çengelköy and Sarayburnu were identified to be under more risks. Early action after accidents would decrease the oil distribution to minimum from these areas” (Başar, 2003).

“Risk map is prepared for Strait of Istanbul. Risky area on Strait of Istanbul is shown in this map (Otay&Özkan, 2005). The risk maps in Figures 4.2 and 4.3 show the computed probability distribution of collision and Ramming/Grounding risk for various vessel lengths in north- and south- bound traffic. Note that the graphs appearing to the left of the risk maps are the discrete casualty risk graphs referring to the according cell. Therefore, it shall not be treated as a continuous probability density function where it is integrated to obtain the total casualty risk in the Strait. Instead, one has to sum all the discrete casualty probabilities belonging to according cells to obtain the total casualty risk”.

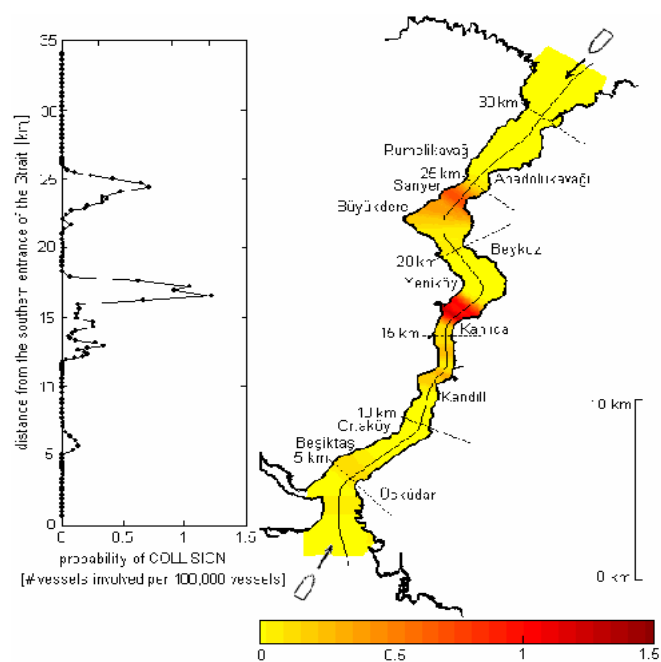


Figure 4.2 : Risk map for collision (per 100,000 vessels)

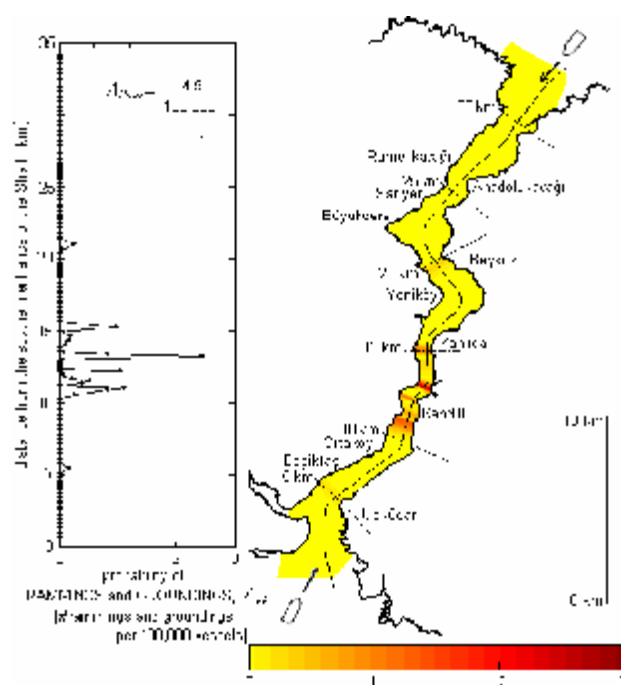


Figure 4.3 : Risk map for ramming and grounding (per 100,000 vessels)

A physics based stochastic simulation has been developed to investigate casualty risk in the Strait of Istanbul with regards to the existing vessel traffic condition. The model results indicate certain regions in the Strait as high-risk regions. It is found that when the same pilotage error is incorporated for all vessel types regardless of vessel size or travel direction, the vessel length directly correlates with the casualty risk. It is also verified in the model that the southbound vessels are at a more disadvantageous condition in terms of ship handling due to the south going surface flow. Therefore, larger southbound vessels are found to be the main cause of the collisions in the Strait of Istanbul. The collision and ramming/grounding risks are evaluated separately. According to the model, the collision risk is higher than ramming/grounding risk in the Strait of Istanbul” (Otay&Özkan, 2005).

CHAPTER FIVE

CONCLUSION

Utilization, control and trade of petroleum, natural gas and coal reserves, which are called fossil fuels will always attract the attention of world countries', unless basic technological steps are taken and studies on alternative energy resources are improved. Researches for reserves in Black Sea region, primarily in the Caspian Basin, which is newly emerged as the soil of energy resources, will steadily increase and oil transportation by navigation will be on the ground as the most important theme of our studies. As in today, 85% of energy consumption will be met through fossil fuels in 2030.

The Turkish Straits System, which will be the route of petroleum, its byproducts and trade from Caspian Basin and the Black Sea, is a natural waterway being convenient to the passage rules and having limited capacity determined by Montreux Convention. Therefore, increase in navigation traffic at the Straits, will lead to collision risks as well as financial loss of ship owners due to the latency. Thus, big projects such as Baku-Tbilisi-Ceyhan (BTC) Pipeline, will not create any positive effects on the passage of ships at the Straits. These projects are aimed at preventing the economical and time losses during boarding in European and other world markets.

Passage through the Turkish Straits has been regulated through the Montreux Convention. Within this convention, the definition of "free passage" as "innocent and secure passage", or in other words, "secure free passage" that is supported by Türkiye, proves to be accurate. All international and regional agreements; including conventions prepared by International Marine Organization (IMO), such as SOLAS, MARPOL, STWC and COLREG, regards minimizing risks and obedience in passage rules as the main principle.

Secure passage, risk management and well-established warning and control mechanism pose great importance at the Turkish Straits, which is one of the narrowest waterways of the world passing through a 12-million city of Istanbul that is announced as “world heritage”,

Turkiye has to reduce steadily increasing navigation and its risks. Regulations introduced in 1994 and Traffic Segregation Regime, brought regular control over passages. In 2003, VTS was launched, which is a warning technology for ships in order not to collide with other ships. Since the implementation of the regulations, collisions decreased back to 10%. Türkiye may decrease and control the risks originating from the passages in the Straits, by formulating her own reasons through domestic law enforcements, as countries like, Argentine, Haiti, Ivory Coast, Nigeria, Philippines, Venezuela, Antigua and Barbuda, Colombia, Dominiques Republic, Puerto Rico, Egypt, Iran, Malaysia, Oman, Yemen and Saudi Arabia. Conflictual points in “secure passage” may be treated through one-sided “principles on preventing pollution”. Environmental protection measures, taken within domestic laws of every single country may be reflected in “General Laws”.

Besides legal regulations, the Marmara Sea and the Black Sea, whose ecological and historical characteristics, and biodiversity is important, should be evaluated as a sensitive region that needs to be protected and announced as “Particularly Sensitive Sea Area” (PSSA) in accordance with IMO criteria, in order to prevent pollutions resulting from navigation through the Straits. As the region takes the advantages of special regime of “sensitive sea area”, the city of Istanbul, the Marmara Sea and the Black Sea, will also be under protection. Big tanker collisions, like *Nassia*, *Volgoneft*, and their consequents will be significant for evaluations. Within the studies on the subject matter, NGO support will also play an important role. At the meetings of IMO, MAIIF and similar organizations, risks, resulting from the increase in navigation through the Straits, should be underlined via pictures and films, investigation reports of collisions should be announced.

Comprehensive and sufficient scientific researches need to be executed in order Straits to be announced as “sensitive sea area” and ecological risks to be unraveled clearly. Integration of scientific researches on the issues of the Turkish Straits and the Marmara Sea, will be useful to explain the issue more clearly. Basic parameters, such as, routine and detailed current measures, plankton definition and biomass promotion, first production measures.

For utilities the conclusion about scientific debates on Turkish Straits and Marmara Sea, all researches should pursue each other. Especially the continuous and detail measurement should be done at Straits such as; plankton definitions, current measures, biomass promotion, first production measurement, seasonal changes followed and their causes should be investigated.

By the terminate of these scientific researches we have had clear , high quality scientific data's and results that can be used for useful and gainful regulation to become law in Middle European countries and Black Sea region countries. Also this situation open way to observe region constantly, if there would be any accident such as tanker crashes, all the data's and results use efficiently to understand the damages on environments. Data's collected in specialize databank that helps to store and reach data's from international concern.

In 2003, through the collection of taxes allowed by the Montreux Convention and some other revenues, Türkiye has launched the system of VTS, which is the very first security building measure in sea transportation. Nevertheless, infrastructure needs to be fortified to minimize domestic sea transportation, enforcing lighthouses, which are overcome by city lights, and promoting companionship.

Standardization of tanker ships according to the IMO conventions and impediments on non-standardized ships, will be one of the most significant measure to be taken. Implementation of regulations should be followed by means of a certificate system formulated duly international conventions.

Another exercise of risk management, is the usage of “Turkish Pilot” in order to impede collisions at the Straits. The Strait of Istanbul, which is a geographically hard waterway with its sharp curves and sudden manoeuvres, should be navigated with the help of domestic seamen, who are acquainted with the waterway. To the ends of improving technical structure of guiding services, and technical control of ships, which is another reason for the collisions, the possibilities of “marine state control” should be launched. In addition to this, intervention capacity of rescue vehicles and materials should be comprehended, as well as financial investments should be improved.

Investigation of collisions within the Turkish territorial sea, especially at the Straits, and explanation of reasons is an influential way to justify the Turkish Straits System at international level. The acceleration of studies of DEKİK, which has been founded to this end, and drawing out the reasons of collisions such as negligence, technical shortfalls, dense traffic, lack of guide captain, geographical characteristics of the Straits, weather report, in the collision report, and distribution of these reports will help introduce Turkish Straits Policy to the world. Demanded result will be taken if only collision investigations will be held at technical and scientific level, because, none of the international entities will be able to oppose scientific realities.

DEKİK was established to serve the aims that; understanding effects of : expanding researches, negligence on accidents reports, technical failure, high intensive traffic, non-use of Turkish pilots, geographical characteristics, weather reports on accidents moreover to complete and distribution accident report. This perspective searching effects of accident and statistics on Turkish Straits are helpful for convinced Turkish political rights in international era. Searching effects of accident and statistics are being esteemed by regional countries.

The "reactive" approach, which had been pursued in the past (e.g., respond only when oil starts to leak) has become scarcely acceptable. There is a growing public demand for "proactive" oil removal from wrecks, including war casualties or other sunken vessels, to remove any significant threat of future pollution (Basta and Kennedy, 2004). The justification is not based on "*if* there will be an oil release" but rather "*when* will the oil start leaking."

Within the framework of scientific studies, preparing, implementing and exercising risk analysis and emergency plans of Turkish Straits System and transportation in the Black Sea, will be beneficial. In order to be able to follow the prosecution procedures efficiently, authorization and coordination among the relevant entities should be examined carefully. Disorder, conflict among these entities should be overcome and issues hardening prosecution should be eliminated. Finally, workings on Emergency Coordination Center should be accelerated, in order to make up necessary communication among relevant entities for a more efficient and fast intervention to the unfortunate collisions.

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APPENDICES

LEGISLATIVE FRAMEWORK OF TURKISH STRAITS SYSTEM

- A) INTERNATIONAL LEGISLATIVE FRAMEWORK**
- B) INTERNATIONAL MARITIME ORGANIZATION**
- C) REGIONAL LEGISLATION**
- D) NATIONAL LEGISLATION**

LEGISLATIVE FRAMEWORK OF TURKISH STRAITS SYSTEM

A) International Legislative Framework

The security in maritime has been overtook national dimension, the convention and politics on the navigation, ships and crew has been accepted such as SOLAS, COLREG and STCW and security codes. It is impossible to be successful on maritime sector without being impartial or to implement the rules properly. Because the standards, that don't conform by one country, may effect closely the security of the other countries. For this reason, nobody may have been expected to be tolerant toward the parts that doesn't perform the rules, any more. Afterwards, these rules may be turned to economic sanction.

The international conventions have been formed after investigating the accident and profit from the accident examples and outcome will be the rules. International Convention for the Safety of Life at Sea (SOLAS) rules was put into practice after TITANIC tragedy. MARPOL was arrange in 1973 after Torrey Canyon accident which causes the petroleum pollution in the English Channel, but signed in 1978 after Amoca Cadiz and Argo Merchant accidents in 1976 and 1977. sThe rules has been changed and improved after the accident of Herald of Free Enterprise, Estonia, Exxon Valdez, Achille Lauro, Braer, Erika and Prestige ships. The Turkish Straits Regulations has been applied after the Nassia Tanker accident which causes an important maritime and air pollution in 1994 (Yalçın C., December 20, 2003).

1. United Nations Convention on the Law of the Sea (UNCLOS 1982)

U.N. Sea Law Conventions was signed by the 157 countries and approved by 62 countries after the 111. Sea Law Conference, and has been put into practice from the date of 16 November 1994. (<http://denizcilik.gov.tr/DOCUMENTS>, Nisan 2006).

2 Organisation for Economic Co-operation and Development (OECD)

3 Basel Convention On The Control Of Transboundary Movements of Hazardous Wastes and Their Disposal

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which was also signed by Türkiye, has been called the World Common Sense attention on the hazardous and noxious wastes transportation problems. The convention consist of 29 Particle and 5 Annexes. It has been valid from the date of 20 September 1994 on the basis of Official Gazette on 15 March 1994 and no 21935, and included the open .is of hazardous wastes. The convention also brought the obligation to the country, which export the wastes, on noticing the list of the wastes. The convention prevents Türkiye, which is on the transit way of transboundary movements, being subjected to the illegal waste traffic and discharge (<http://www.denizcilik.gov.tr>, April 2005).

4 International Convention for the Prevention of Pollution of the Sea by Oil, OILPOL

Ratified on May 12, 1954 in London, it became effective July 26, 1958. OILPOL was amended twice, on April 11, 1962 and October 21, 1969, respectively. Its objective is to take actions prevent oil pollution of the sea caused by discharges from oil tankers (Türkiye Çevre Vakfı, 1999).

5 Convention on the High Seas

Signed in Geneva on April 29, 1958, it became effective on September 30, 1962. The environmental goals are to prevent marine oil pollution from ships or pipelines, and monitor seabeds to prevent pollution created by oil production and consumption (<http://www.un.org.law/ilc/texts/hseas.htm>, July 2006).

B) International Maritime Organization (IMO)

While the international maritime transportation has been developed rapidly, the maritime ecosystem conservation, prevention of the maritime environmental pollution and the navigation security has become an important from the second half of the 20th Century. Thus, the global cooperation organization charts has been needed to be formed. Consequently, The International Maritime Organization (IMO) was established in 1948 by the UN. The main issue is to provide the international standards on the maritime security and environmental conservation. Türkiye, which is surrounded by the sea from the 3 sides, is a charter member of the organization and carry on effective action in the organization since 1958. Türkiye spent an active effort to participate in IMO's activity such as maritime navigation security and maritime environment conservation, when became an significant position by selecting the council member in 19 November 1999 and play an effective role in improving the national standards. In the 21st General Assembly of IMO in London, Türkiye got the 76 vote in the 124 total votes as being the member of the Council. The rate of the vote displayed the worth of Türkiye at the international maritime issue (<http://www.byegm.gov.tr/yayinlarimiz/ANADOLUNUNSESI/160/AND7.htm>).

IMO Conventions, Protocols and Annexes That Türkiye Participates In :

i) International Convention for the Safety of Life at Sea (SOLAS)

This Convention is the most detailed and basic study for Safety of Life at sea from IMO. The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948 and the fourth in 1960. The 1960 Convention - which was adopted on 17 June 1960 and entered into force on 26 May 1965 - was the first major

task for IMO after the Organization's creation and it represented a considerable step forward in modernizing regulations and in keeping pace with technical developments in the shipping industry. The intention was to keep the Convention up to date by periodic amendments but in practice the amendments procedure incorporated proved to be very slow. It became clear that it would be impossible to secure the entry into force of amendments within a reasonable period of time.

As a result, a completely new Convention was adopted in 1974 which included not only the amendments agreed up until that date but a new amendment procedure - the tacit acceptance procedure - designed to ensure that changes could be made within a specified (and acceptably short) period of time. Instead of requiring that an amendment shall enter into force after being accepted by, for example, two thirds of the Parties, the tacit acceptance procedure provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of Parties. As a result the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended.

The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Control provisions also allow Contracting Governments to inspect ships of other Contracting States if there are clear grounds for believing that the ship and its equipment do not substantially comply with the requirements of the Convention - this procedure is known as port State control. The current SOLAS Convention includes Articles setting out general obligations, amendment procedure and so on (<http://www.imo.org/Conventions/contents.asp>, July 2006).

This Convention came into force 09.07.1986 in Türkiye

ii) Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)

The 1972 Convention was designed to update and replace the Collision Regulations of 1960 which were adopted at the same time as the 1960 SOLAS Convention.

One of the most important innovations in the 1972 COLREGs was the recognition given to traffic separation schemes - **Rule 10** gives guidance in determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes.

The first such traffic separation scheme was established in the Dover Strait in 1967. It was operated on a voluntary basis at first but in 1971 the IMO Assembly adopted a resolution stating that observance of all traffic separation schemes be made mandatory - and the COLREGs make this obligation clear.

Turkiye is part of this Regulations signed at 18.11.1984.

iii) International Convention on Load Lines 1966 (LOAD LINES 66)

It has long been recognized that limitations on the draught to which a ship may be loaded make a significant contribution to her safety. These limits are given in the form of freeboards, which constitute, besides external weathertight and watertight integrity, the main objective of the Convention.

The first International Convention on Load Lines, adopted in 1930, was based on the principle of reserve buoyancy, although it was recognized then that the freeboard should also ensure adequate stability and avoid excessive stress on the ship's hull as a result of overloading.

In the 1966 Load Lines convention, adopted by IMO, provisions are made determining the freeboard of ships by subdivision and damage stability calculations. In this convention, “Loading limit marks” are determined for ships which are bigger than 150 GT.

The regulations take into account the potential hazards present in different zones and different seasons. The technical annex contains several additional safety measures concerning doors, freeing ports, hatchways and other items. The main purpose of these measures is to ensure the watertight integrity of ships' hulls below the freeboard deck (<http://www.imo.org/Conventions>, May 2006)

Turkiye is part of this Regulations signed at 28.06.1968.

iv) International Convention on Maritime Search and Rescue, SAR 1979

v) International Convention on Tonnage measurements of Ships, 1969 (TONNAGE 1969)

vi) International Convention on Standards of Training Certification and Watchkeeping for Seafarers STCW'1978,

vii) Convention and Operating Agreement on the International Maritime Satellite Organization (INMARSAT 1979)

viii) International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)

ix) International Convention on Oil Pollution Preparedness, Response and Co-operation, OPRC 1990

x) International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, INTERVENTION 1969

This was accepted in Brussels on November 29, 1969 and became effective on May 6, 1975. Its aim is to ensure that countries take necessary actions on the high seas for accidents that may cause marine and shoreline oil contamination (Türkiye Çevre Vakfı, August 1999).

The Convention which resulted affirms the right of a coastal State to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate danger to its coastline or related interests from pollution by oil or the threat thereof, following upon a maritime casualty.

The coastal State is, however, empowered to take only such action as is necessary, and after due consultations with appropriate interests including, in particular, the flag State or States of the ship or ships involved, the owners of the ships or cargoes in question and, where circumstances permit, independent experts appointed for this purpose.

A coastal State which takes measures beyond those permitted under the Convention is liable to pay compensation for any damage caused by such measures. Provision is made for the settlement of disputes arising in connection with the application of the Convention.

The Convention applies to all seagoing vessels except warships or other vessels owned or operated by a State and used on Government non-commercial service (<http://www.imo.org/Conventions/contents.asp>, July 2006).

xi) International Convention on Salvage, 1989

The Convention replaced a convention on the law of salvage adopted in Brussels in 1910 which incorporated the "no cure, no pay" principle under which a salvor is only rewarded for services if the operation is successful.

Although this basic philosophy worked well in most cases, it did not take pollution into account. A salvor who prevented a major pollution incident (for example, by towing a damaged tanker away from an environmentally sensitive area) but did not manage to save the ship or the cargo got nothing. There was therefore little incentive to a salvor to undertake an operation which has only a slim chance of success.

The 1989 Convention seeks to remedy this deficiency by making provision for an enhanced salvage award taking into account the skill and efforts of the salvors in preventing or minimizing damage to the environment (<http://www.imo.org/Conventions/contents.asp>, July 2006).

xii) The International Convention on Civil Liability for Oil Pollution Damage, 1992 (CLC' 1992)

xiii) The International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1992 (FUND' 92)

xiv) Convention on Limitation of Liability for Maritime Claims, 1976 (LLMC 1976) (04.06.1980)

The LLMC 1976 limits shipowners' liability for claims in respect of personal injury and property loss such as damage to other ships, property or harbour facilities. Since the Convention came into force internationally in 1986 (<http://www.mardep.gov.hk/en/aboutus/pdf>).

C) Regional Legislation

1 Convention on the Protection of the Black Sea Against Pollution in Bucharest, Romania, in April 1992 (the Bucharest Convention, or the Black Sea Convention) and Black Sea Emergency Response Plan.

The Contracting Parties to the Convention on the Protection of the Black Sea Against Pollution - Bulgaria, Georgia, Romania, Russian Federation, Turkey and Ukraine, committed themselves to;

"...take individually or jointly, as appropriate, all necessary measures consistent with international law and in accordance with the provisions of this Convention to prevent, reduce and control pollution thereof in order to protect and preserve the marine environment of the Black Sea" (Article 5, paragraph 3)

Four Protocols to the Black Sea Convention are enforced in the Black Sea Coastal States including the Protocol on Co-operation in Combating Pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations, 1992.

Expected two fold increase of transport of Russian and Caspian oil via Black Sea particularly through Russian and Georgian marine ports , progressing exploration of oil and gas deposits in the Black Sea proper in Ukraine and Turkey, Romanian oil rigs and potential expansion oil terminals and oil pipelines in Bulgaria calls for the strengthening safety measures and setting up the up-to-date oil spill response system.

In line with provisions of this Protocol and supported and guided by International Maritime Organization (IMO) the Advisory Group on Environmental Safety Aspect of Shipping of the Black Sea Commission prepared a Draft Black Sea Contingency Plan and submitted it to the Black Sea Commission. •

In 2003 The Black Sea Contingency Plan to the Protocol on Co-operation in Combating Pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations (Emergency Protocol), Volume I, Response to Oil

Spills, 2003 in response to increasing intensity of oil transport and subsequent potential risk of oil spills was approved by the Black Sea Commission and signed by Romania, Bulgaria and Turkey. Georgia, Russian Federation and Ukraine finalize their internal procedures for signing the Plan. The first steps towards practical implementation of the Black Sea Contingency are being undertaken by the Black Sea Commission institutional network in close cooperation with Oil Spill Preparedness Regional Initiative (OSPRI).

In promoting the practical implementation of Black Sea Contingency Plan the BSC Advisory Group on Environmental Aspects of Shipping in 2005 the close with Oil Spill Preparedness Regional Initiative conducted the first Black Sea Training in Pollution Reporting (POLREP) under the Black Sea Contingency Plan and elaborated a detail schedule for conduction POLREP drills in 2006. Assisted by OSPRI the Advisory group adapted HELCOM Manual for the purpose of the Black Sea Contingency Plan and started to work on the improvement of the template for the Directory of Response Personnel and Inventory of Response Equipment, Products and Other Means Which Each Party Might Offer as Assistance in Case of the Activation of the Plan.

In January 2006 the first Black Sea BRAVO drill was initiated and conducted by Bulgaria, the second drill will be repeated in the second quarter of 2006 by Georgia and elements of the Black Sea Contingency plan will be tested in June, 2006 during bilateral Russian -Turkish exercise (Tarasova O.,InterSpill, 2006).

2 Memorandum of Black Sea

D) National Legislation

1 Environmental Law

2 Reception Of Wastes From Ships And Waste Control Regulation

This Regulation, which became effective upon publication in the Official Gazette issue 25682 and dated 26.12.2004, is for the purpose of preventing the release of

wastes stemming from the normal activities of ships to the marine environment in sea areas under the jurisdiction of Turkey, to regulate the procedures and guidelines for the operations with regard to reception of wastes from ships, storage thereof, and transferring of wastes to disposal facilities and for the waste reception facilities and waste reception ships required to be established and operated in ports therefor.

The provisions of this Regulation apply to the ships in sea areas under the jurisdiction of Turkey, the waste reception facilities required to be established in the ports in these areas, waste reception ships and transferring of wastes to disposal facilities (<http://www.denizcilik.gov.tr/mevzuat>, June 2006).

3 Maritime Traffic Regulations For The Turkish Straits and The Marmara Region

This Regulations came into force June 1, 1994 and was revised 1998. The purpose of Vessel Traffic Regulations is to ensure safety of navigation, safety of life, property and marine environment by improving the safety of vessel traffic in the Straits. These regulations shall apply to all vessels entering or navigating within the limits of Turkish Straits.

The purpose of Vessel Traffic Regulations is to ensure safety of navigation, safety of life, property and marine environment by improving the safety of vessel traffic in the Straits. These regulations shall apply to all vessels entering or navigating within the limits of Turkish Straits.

4 Act On Guidelines For Response To Emergencies and Compensation of Losses in Case of Pollution of The Marine Environment From Oil And Other Harmful Substances

The Act, which became effective upon publication in the Official Gazette issue 25752 and dated 11.03.2005, is taking into account rights and obligations emanating from international law and the domestic law on ensuring of marine safety and prevention of marine pollution; to establish;

- a) the guidelines for intervention and preparedness to be applied in emergency situations in order to eliminate the risk of pollution stemming from ships and facilities on the shore or to decrease, limit and remove pollution,
- b) the guidelines for the determination and compensation of losses resulting from the incident,
- c) the guidelines for the performance of international obligations,
- d) the powers, duties and responsibilities of the persons covered by the Act and of the authorities defined in the Act of the institutions, organisations, ships and facilities covered by the Act.

This Act covers the powers, duties and responsibilities of the authorities of the ships in the areas of application or who wish to enter the areas of application for any reason whatsoever, which have a capacity of five hundred gross tons or more, carrying oil or other harmful substances; of the authorities of shore facilities engaged in activities with oil or other harmful substances which might cause pollution; of ministries; and of public institutions and organisations.

War ships and auxiliary war ships and ships belonging to any state or operated by the state and used for non-commercial activities are not covered by the Act.

5 Regulation on the Analysis of Marine Accidents (DEKİK)