PROBLEMS OF SEA-GOING NAVIGATION IN KERCI STRAIT

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ABSTRACT. Kerch Strait was the main passage between the Azov Sea and the Black Sea.The passage of ships through the strait is hampered by several physical and geographical factors: emerged and submerged morphology, the climatic and hydrological parameters. As a result of the extremely low depths of the strait, for the safety of navigation, authorities have been forced to dredge a canal for passage of the vessels with a medium draft, to make a properly hydrographical development of the fairway and of the shores, and to establish a favorable anchoring area etc. Ice, which occurs in winter, makes the navigation very difficult, which takes place in convoys, preceded by ice breakers. Fog, frequent in the transitional seasons, hampered navigation; many accidents happened because of this inconvenience. Most accidents due to weather conditions (fog, wind) are specific to smaller vessels, sea-river type, which are sailing in the area and which, due to their construction, are not able to deal with exceptional weather conditions at sea. The existence of surface currents, with the dominant direction north-south, from the Sea of Azov to the Black Sea, affects navigation only around the heads where causes circular currents. In this case are affected only pleasure boats and low powered vessel. With all these impediments to navigation, the Kerch Strait is an important waterway, especially for the countries bordering the Sea of Azov: Ukraine and the Russian Federation, and also for the countries from the Black Sea basin.

Keywords: straits, shipping, hydrological risk, morphology, hydro-climatic conditions

1. INTRODUCTION

Although the Azov Sea is considered an inland sea, navigation is extremely intense because the bordering countries: Ukraine and the Russian Federation, runs a large part of the commercial transports through the Kerch Strait. In this context, the strait acquires a special importance and local authorities are working to maintain and keep it operational, at maximal potential.

In geographycal, physical and human terms, the strait has been extremely well studied, but the interdisciplinary connection, between natural conditions and navigation, was only vague studied. This research attempts to highlight certain links between natural environment and navigation, especially the difficulties created to the naval traffic, by the existence of risk factors.

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The great difficulty in the finalization of this work, is the fact that most of the dates required in the conduct of this study are not concentrated on a single customer, but at several authorities who are very reluctant to provide informations. For this reason it has been used only material obtained via mapping and interpretation of raw data from meteorology and hydrology.

For navigation in the Black Sea, Azov Sea and the strait were printed materials with a general and especial character by United Kingdom Hydrografic Office, 2006, 2009-2010, Direcţia Hidrografică Maritimă Constanţa, 2006 and Service Hydrographique et Oceanographique de la Marine, 2004. In this direction can be used the reference works edited by: Penck, 1919; Brătescu, 1942; Gâştescu, 2005; Romanescu, 2007; Ştefan and Romanescu, 2010 a,b etc.

2. REGIONAL SETTING

Kerch Strait link the Black and Azov Sea. To the west the strait is bounded by the Kerch peninsula (belonging to the Autonomous Republic of Crimea, Ukraine), and eastwards from the Taman peninsula (belonging to the Russian Federation). This mean that at present times, the border between these two states, is established in the middle of fairway. South Entrance, from the Black Sea, lies between the heads Panagiya and Takil and the north, from the Sea of Azov, between heads Akhilleon and Khroni (Fig. 1).

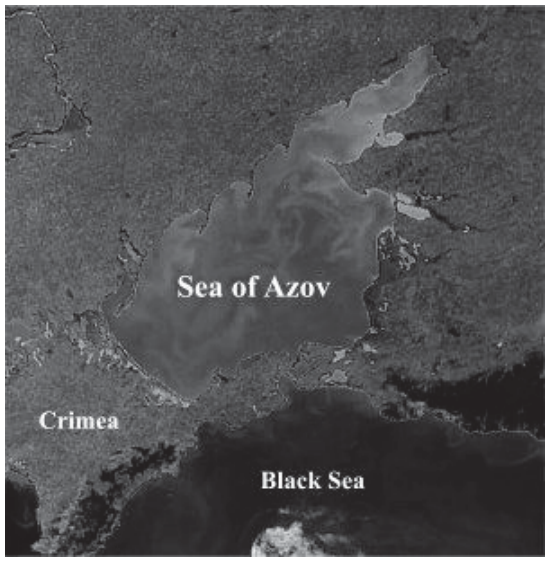

Fig. 1. ***Sea of Azov – Satellite image,*** **after NASA, 2004**

Kerch Strait length is 22 Nm and the width is less than 2 Nm. Although its width can be considered satisfactory, a large number of sand banks, shoals and other hazards required the dredging of a canal, to allow the navigation at the ships with a medium draft (Kerch-Yeni Kale Canal).

There is an obvious difference between the coasts of west and east of the Strait. West coast is higher, bordering Komish-Burun and Kerchenska bays, while the east is lower, showing sand spits (Tuzla, Chushka) that border the Gulf Taman.

The strait's route is sinuous and narrow. Hydrographic factors, in addition to the natural morphologie, are extremely variable and misleading, making navigation very difficult due to busy traffic along and across the strait. Despite these difficulties, Kerci Strait remains very important for navigation, being the single waterway linking the Black and Azov Sea.

Coordination of shipping movement in the area is provided by the Ship Movement Control Service located at the Cape Zmeinyy (on the Ukrainian coast), which regulates navigation in Kerch Strait, Kerch-Yeni Kale Canal and Sea of Azov.

3. METHODS, TECHNIQUES, MATERIALS

For such action is necessary a labor team, from which to obtain and analyze information from different sources and different areas.

The most important information was taken from the cartographic material used in navigation, and also from studies developed by geologists, geomorphologists, hydrologists, meteorologists, etc..

The details of the manouevers to be carried out, in difficult conditions for navigation were taken from nautical publications and also from a personal experience at 25 years, of deck officer and master on board of sea-going vessel.

At the same time were consulted informations from media, regarding the accidents occurred in the Kerch Strait area, or the Black and Azov Sea basin.

Kerch hydrological and meteorological stations have provided the most important data about currents, waves, fog, strong winds etc. All these are published in a brut style in the United Kingdom Hydrographic Office publications.

4. RESULTS

Azov Sea is considered, by many geographs, an adiacent lagoon of the Black Sea, named Don lagoon, which communicate via the Kerch Strait (United Kingdom Hydrografic Office, 2006). It has an area of 38,000 km2 and a maximum depth of 14 m, and is known as the shallowest sea of the world. Its shape is elongated, with major axis oriented NE-SW direction. Maximum length is 400 km. Maximum width of 200 km, on the Berdyansk meridian, and average width is 95 km.

Navigation is allowed in this basin, for small and medium draught vessels (up to 8 m) and a displacement of up to 12,000 tdw. The main reason is due to very low depths. Navigation is also strongly impeded because the lenses are aligned perpendicular in profile sedimentation, (Scherbacov et al., 1979).

The shores are sandy, with numerous spits and coastal belts of sand, leaving few areas favorable for the arrangement of ports. Therefore the only ports

capable of receiving vessels with medium-draught, are in Ukraine, Berdyansk and Mariupol (Zhdanov old name) ports, having a maximum depth of 8m. Russian ports situated in eastern and north-eastern side of this sea (Temryuk, Eysk, Taganrog, Rostov on Don) have lower depths, and here is operating only low draught vessels (sea-river, river type vessels and barges).

Bordering areas have rich mineral and agricultural resources. There are large deposits of coal and iron in the Don River basin and large oil reserves in the Kuban River basin.

Azov Sea waters are muddy green color and are opaque due to high content of silt brought by rivers . At the same time are also large quantities of plankton, and in late summer sea surface is almost completely covered with green-brown algae.

In the Kerch Strait area, **topography** is the most important factor which endangering shipping. Emersion and submerged topography of the Kerch Strait presented numerous hazards to navigation. At the entrance area from the Black Sea, near the capes are numerous reefs, banks and underwater obstacles. Near the Tuzla Cape, are underwater rocks, benches and pillars, and south of the Yeni-Kale Cape are Tserkovni Banks. Numerous impediments are on both sides of the Kerch-Yeni Kale Canal, especially in the east part of the canal. The hazards located on the faiway, near the dredged canals, or near passes are marked by lighted or unlighted buoys and spars.

Depths in the Kerch Strait are reduced. Greater depths are at the entrance in the strait from Black Sea and Azov Sea. In the middle of the strait, depths fall gradually, and south of the Cape Yeni Kale are less than 5 m. Due to this situation, was necessary to dredge a canal in this area. In the middle of the Strait draft vessels can navigate only through this canal.

Kerch-Yeni Kale Canal is dredged in the north part of Kerch Strait and serves for the passage of vessels with a medium draught (until 8 m). On both sides of the Canal coast is usually high. On its west side the coast is indented by bays and inlets. On the east side, sandy spits are extending near the coasts. It has a length of 18.5 Nm, a general direction NE-SW, and is buoyed. The canal have four sections (from the Black Sea): Pavlovskoye, Burunskoye, Yeni Kale and Chushkynskoye. It has a minimum depth of 8 meters and a width of 120m (Tab. 1).

Section	Minimum depth (m)	Width (m)
Pavlovskoye	8,3	120
Burunskoye	8,3	120
Yeni Kale	8,0	120
Chushkynskoye	8,2	120

Table 1. ***Depths in different sections of the Kerch-Yeni Kale Canal, after the Black Sea Pilot Book, 2006.***

Latest information on minimum depths can be obtained only from the Ukrainian authorities, who manage this canal. They always perform dredging

operation, to maintain the officially declared depths. Legal and material they are liable in case of an accident due to water level.

On the entire length of the canal, near its edges, there are a great number of hazards to navigation, so it must be carried out only in the middle of the fairway. It deviates outward only on head-to-head meeting with another vessels (Fig. 2).

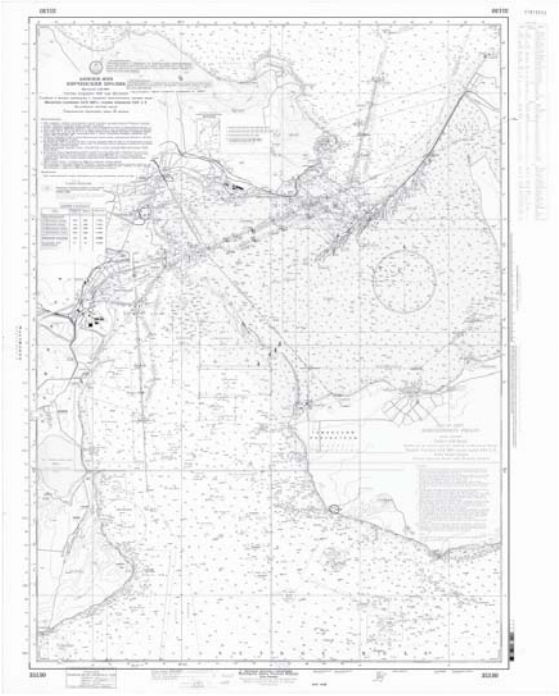

Fig. 2. ***Morphology of the Kerch Strait and passage routes***
Map by Russian Maritime Hydrographic Office , 2008

The canal is marked by pairs of lighted and unlighted buoys, numbered sequentially from the southern entrance, from 1-2 to 51-52, signaling port and starboard part of canal. Each section of the channel is marked also by cardinal buoys. Anchorages are clearly established by local authorities and marked on navigational charts (Fig. 3).

Most important **hydroclimatic factors** are: **ice, currents, water level, fog, winds.**

During the winter (second part of December to March) navigation in Kerch Strait and Sea of Azov is often obstructed by the appearance of **ice**. In this case, navigation is carried out using icebraker. The ice cover can be broken also under the influence of currents or winds. In hard winters the entire area is covered by a compact cover of ice. Ice normally disappears in the second half of March. Azov Sea ice under compact form or enter into the Kerch Strait up on spits Chushka and Tuzla. It can also penetrate up to the southern part of the strait.

Kerch Strait **currents** are influenced by wind direction and the flow of water in the Sea of Azov. Due to the predominance of winds from the N direction, current have usually the direction S. A stream of N direction, from the Black Sea, occurs more frequently when prevailing winds from S direction. Average current speed is between 0.1 and 0.5 Kn, but in narrow places where the wind speed increases, can reach 3 Kn.

Water level in the strait decreases, while winds from the direction N prevailing, and increases, during strong winds from the direction S. The maximum amplitude may be about 1 m.

Fig. 3. ***Kerch Strait – Electronic navigational chart, after Tsunamis, 2002***

In the past, the most important impediment to coastal navigation in the Strait of Kerch was represented by **fog**. Due to the new facilities, the radar survey equipment and also the appropriate signals, this phenomenon is now greatly diminished. Fog is now a hazard only for small or fishing vessel without proper radar equipment. The frequency of fog is higher in the transitional seasons (spring, summer) and in winter times, in the morning. There is a certain connection between phenomena of the occurrence of fog and shipping accidents in the strait, but not very obvious.

Winds have the entire year, a general NE-SW direction, focusing along the corridor, easy favoring navigation on south direction, preventing it from the opposite direction. SW winds occur in summer and beat normally during the

day. When lateral winds are in force, vessels must be positioned as to respect the mandatory route and fuel consumption, and attention is increasing. Small tonnage ships can strand at strong side winds, but have a little influence on large tonnage ships. Strong winds have a common NE direction in autumn and winter. They have produced over the years, many naval disasters. In the last years, the worst naval accidents in the Kerch Strait took place in November 2007, after a severe storm. These events have terrified the European Community and led to special measures for maritime safety.Studying the media of the time, I could make a complete description of the severity of accidents occurring and their adverse influence to the marine environment.

A very strong storm, with winds from the NE direction, force 8 / 9 Beaufort Scale (17-24 m / s) and sea grade six ("very agitated", with waves up to 6 meters, according to the sea scale depending on the height of the wave), caused a first disaster , on 11 November 2007 at 4.45 local time (3.45 Romania), in the Kerch Strait, where the Russian tanker "Volga-Neft 139" was torn in two, front drifting, according RiaNovosti. The tanker was carrying 4,000 tons of oil, and it was estimated that over 1300 tons of oil leaked into the Black Sea.

Shortly after the first incident, the cargo ship "Volnogrosk", loaded with 2,000 tons of sulfur, and the tanker "Volga-Neft 123" were damaged by the same storm, near the Russian port of Kavkaz, also in Kerch Strait. Crew members were rescued from the ship's lifeboat, which floated on the sea for several hours. A final assessment of the consequences of the storm of November 11, 2007, recorded a total of 13 ships damaged.

5. DISCUSSIONS

Most accidents occurred in the Kerch Strait were caused by human negligence or due to unfavorable hydro-climatic conditions.

The riparian countries, must to take special measures for improvement of maritime safety and for prevention of marine pollution. In this regard it is necessary a proper regulation of traffic, improving of hydrographic assurance for navigation and hydro-meteorological information in the area.

To regulate traffic were adopted traffic separation schemes at the entrance to the north and south of the strait, anchorage areas, avoiding areas, etc. (Fig. 2,3).

For the safety of navigation, in the Kerch Strait, deck officers are required to make a permanent navigational and radio watch, for immediate notification of any changes in the operational environment. This permanent watch is made, *on the sea*, to: avoid areas with bad weather, prevent difficult situations that can find the ship in a storm, choose the best courses in relation to wind and wave direction depending of loading situation, prepare for the maneuvers of the vessel at a given time; *on station at anchor* for : timely preparation of maneuver to heave up the anchor, quickly leaving of the anchorage place, preparing the voyage to outer road or open sea; and *at the quay*, to: multiply the shore lines for the safety ; stop or restrict the loading operation, etc.

6. CONCLUSIONS

Kerch Strait is the only link which connects the Azov Sea with Black Sea and planetary Ocean, and riparian countries (Ukraine, Russian Federation) must to use only this sealane. Due to this fact, the strait has a high strategic, economic and geopolitic importance for this countries and also for countries from south-east of the EU. Morphografical and morphometrical characteristics, climatic conditions and sea currents, are natural factors, that can positively or negatively influence the navigation through strait.

As a result of the natural conditions (sinuous shores, low depths, many navigational hazards), and of the adverse hydro-meteo factors (surface currents, ice, fog), navigation is difficult and sometimes dangerous. For this reason, the Strait technical equipment must to be modern and efficient, and the dredging permanent. Despite of all facilities owned by the infrastructure of the strait, catastrophic accidents still happened and navigation is often interrupted because of hydro-meteorological risk phenomena.

ACKNOWLEDGEMENT

Many information was obtained from the logs of the training merchant vessel “Albatros”, owned by Naval Academy "Mircea cel Bătrân” and from the notes of the captain Marius Stefan.

Processing and interpretation of data was performed in the Laboratory of Geo-Archeology of the Faculty of Geography and Geology at the University "Alexandru Ioan Cuza", Iaşi.

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