This book has been written in memory of those whose lives have been lost to the sea.

Seafarers, fishermen and marine researchers know the restless sea waves and the storm gales, the heavy rain and soaking wet humidity, the extreme heat and cold, the fearful collisions, the fires, or the hard to break ice-sheets, when there is nothing romantic about being away from land. In various manuals you can find simple instructions for this most difficult of all environments to survive (the desert, the harsh polar regions and the tropics (among the snakes and deadly diseases) are considered easier). Your ability to stay alive in a marine environment depends upon:

- Your knowledge of and ability to use the available survival equipment;
- Your specialist skills and ability to apply them to cope with the hazards you face;
- Your will to live and ability to keep your head (stay smart).

Undoubtedly, and especially during an accident at sea, all this knowledge, skill and will, listed above, is crucial in the matter of life and death. However, there are better ways to survive in this unsteady world and these lie in precaution and preventative measures. As is well known, the Kerch accident happened because of a heavy storm, lives were lost and gallons of oil leaked into the sea causing a catastrophic environmental disaster. Of course, storms at sea may be extremely destructive and we cannot prevent them. However, these storms are predictable. All you can do when they are forecast to strike is listen to the early warnings and remove yourself from harm's way. The Kerch storm was forecast well in advance. Therefore, why did the Kerch accident happen, what prevented the people from acting more quickly in looking for a shelter and safe harbour? What did we learn from the Kerch accident? What should we do to avoid other accidents and to prepare well for emergency situations? We have written this book to answer these and similar questions and to communicate our findings to a wider audience.

Whilst drafting this book, we have received many different comments, some of them useful, others less. We have accepted all those comments that were from people who know the sea personally i.e. those whom have worked at sea, whom have risked their lives under difficult conditions and who have known critical situations from their own experience. Being 'out of the sea' and away from danger, comfortably sat in your arm-chair, it is easy to criticize how the 'political sensitivities' of the Kerch accident were handled. This involved talking openly about gaps in legislation and policy, use of old or inappropriate ships, non-qualified staff, commercial interests and illegal ship transportation, lack of capacity to save wild life or to utilise waste products, quality of clean-up operations at sea and on coast, the chronic pollution in the Kerch Strait, and many other important issues. For those who have never worked at sea – we know that it is impossible to picture the despair and fear in an accident or in an emergency if you have never been in at least one storm away from land or maritime incident. However, imagine that your child works at sea – what would you do to spare him or her from an accident, have you even ever thought of this possibility? With this book we have aimed to increase public awareness on issues related to governance of environment protection in the Black Sea region and to advocate

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for transparency, hence wider public participation and bottom-up control, especially during accidents. We have used the 'political sensitivities' to sharpen your attention and to engage as many people as possible to concentrate on issues which would help in practice to better manage the risks at sea, saving human lives and protecting the environment more efficiently through enhancing the safety aspects of shipping.

The book is based on ideas born in the Black Sea Commission and is supported financially by the EC/BSC project MONINFO (http://www.blacksea-commission.org/_projects_MONINFO.asp). In fact, the Kerch accident triggered discussions in the European Parliament about the safety of the Black Sea bearing in mind the plans of the Black Sea states for a several-fold increase in oil transportation and export capacities, the activities (on-going and envisaged) in oil/gas extraction and the new energy projects discussed. The European Parliamentarians mentioned in their Resolution from 13th of December 2007 (http://eur-lex.europa.eu/) the key role that Black Sea regional organisations, in particular the Organisation for Black Sea Economic Cooperation (BSEC), can play in ensuring better management of and cooperation in seafaring on the Black Sea. In 2009 the EC provided substantial financial assistance to the Black Sea region to enable the coastal states to better prevent and respond to operational, accidental and illegal oil pollution. This financial assistance is managed by the BSC, the regional focal point in environment protection, in the frames of the MONINFO project mentioned above. This project will ensure by the end of 2011 the development of modern regional monitoring and information systems for the Black Sea to control oil pollution and its potential sources, and to enhance the maritime safety in the Black Sea region. In line with the main goals of the MONINFO project, the Kerch accident was analysed (as an event which happened as a consequence of natural disaster and human mistakes), contributing to clarifying the level of regional preparedness to accidents and efficiency of response to oil spills in the Black Sea region.

We hope this book will be equally interesting to professionals and non-professionals. It is a mixture of scientific and administrative approaches to the retelling and analysis of the events around the Kerch catastrophe of 11th of November 2007.

The ultimate purpose was to learn from the accident, to not let it slip into history without drawing and conveying the lessons learnt in as wide a context as possible. For instance, during the past 50 years, more than 10 accidents on a scale much larger than the Kerch Strait disaster have occurred in the Black Sea and its straits. We are fairly sure that only a few people remember them and about their disastrous effects. The book you hold in your hands is the first one to remind the people in the Black Sea region that accidents still happen too often in the Pontus Euxinus , to tell the story of one of them in detail, and to reiterate the need to better understand the sea's hospitality, to cherish it and use it without conflict and risking human life.

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The Balaklava storm and the numerous ships (from the Turkish-Anglo-French navy) in distress are shown in a single antique lithography from 1854 (reprint on the left). The Kerch storm and consequent disasters you can better visualize and understand through the numerous photos provided in this book. The authors of the book (you will find their names in the beginning of the different chapters) wrote it with great love and true devotion to the protection of the Black Sea and with the sincere wish to further contribute to the increased security in the region.

The editors and their colleagues spent many months in order to produce a well compiled text and high quality figures and photos. Although conducting an evaluation of a maritime accident can seem like a daunting task, we relished very much the process. The analyses of the Kerch catastrophe highlighted successes and failures; we believe the insight and clarity gained on the basis of this case-study will become incentives to further improvements of maritime safety in the Black Sea region.

This book reflects an enormous group effort. We are obliged to the interest and encouragement of many people who supported us from the very beginning and made this book possible. This most comprehensive compilation of materials available on the Kerch accident appeared thanks not so much to the financial assistance provided, as divided in between the numerous authors and contributors it became a minor incentive. The book was born because many people in the Black Sea region became excited about such a publication and worked hard to make it happen. It was a great pleasure for us to collaborate with such an enthusiastic team. We have been also fortunate to have significant feedback on the drafts from highly qualified specialists, which helped us to improve the book before its finalization. Officials from Russian Federation and Ukraine Ministries, experts from maritime administrations and other organizations working in the field of management of safety aspects of shipping or environment protection, in general, and more than 80 prominent scientists studying the Black Sea ecosystem have contributed to this book. Each chapter has been developed and then more than ten times redrafted with the participation of dozens of experts from different organizations. We would like to acknowledge the contribution of a number of individuals, who participated not only in the writing and revising of the book, but also to provision of materials, organization of cruises, which collected those materials, who commented constructively on the book or helped to illustrate it attractively.

We would like to acknowledge the support of the AzNIIRKH Director Dr. S.Agapov, who provided all the materials of the Institute collected in November 2007-2008 in the Kerch area, where 42 scientists worked hard to summarize the findings of the complex monitoring conducted after the Kerch accident in comparison with previous long-term investigations.

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It is worth mentioning that on the next day a cold, clear weather settled down, which correlated well with the meteorological data about a cold front passage.

Photo: B.F. Timm. Crush of the Turkish-Anglo-French navy near Balaklava, during the storm, November 1854. Lithography. A collection of R.Ya. Shterengarts. Moscow. Taken from the web site http://chekist-07.boom.ru/balaklava/zametki/shtorm.htm

The storm on 28-29 January 1968 was also considered to be among the strongest on the Eastern Black Sea by its intensity, duration, coverage area and consequences (Ikonnikova L.I. 1977; Zdanov A.M. et al., 1968). That outbreak of cyclonic activity over the Black Sea followed on a build-up of a deep stationary cyclone (985 hPa in the centre) between two anticyclones – a warm one in the South-East (over the Caucasus) and a cold one in the North-West of Europe. The wind over the Black Sea proper was controlled by a secondary cyclone which had formed over the Asia Minor in the Southern part of the stationary cyclone and was moving to the Black Sea gradually deepening to 990 hPa in the centre. That secondary cyclone crossed the Turkish Anatolia coast at a speed of 50 km/h and reached the Kerch Strait on 28 January 1968. During the night of 27-28 January, the wind velocity had sharply increased and the westerly near the Turkish coast reached 30-34 m/sec with a windy zone exceeding 100 km in radius. Following the cyclone

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trajectory, the zone jointly with the hurricane winds moved towards the Kerch Strait extending to the whole Black Sea. The winds blew at a speed of 20-30 m/sec in the Black Sea interior and up to 35 m/sec by the Crimean Peninsula. The maximum wind speed (30-34 m/sec) zone reached the Caucasian coast by the evening of 28 January. That storm was unusual due to occurrence of the long waves which caused a 1.5-m sea-level rise at the Caucasian coast, and 9-10 m wind waves that crashed at the Sochi pier producing the 30-40 m high splashes (Zdanov A.M. et al., 1968). In their result, the coastal railway and houses were over flooded.

A similar storm brought by a Southern cyclone, though accompanied by a smaller decrease in the atmospheric pressure, occurred on 12-16 November 1981. During that storm the cyclone centre stayed over the Crimea for three days. The isobars and its followed geotropic wind flow on the Eastern storm periphery rushed to the Kerch Strait in parallel to the Caucasus Mountains. The wind reached its maximum over the North-Eastern Black Sea.

In recent times, a similar storm on 14-16 November 1992 inflicted a heavy material loss to result in destruction of the oil and gas rigs in the North-Western Black Sea, and concrete constructions, while washing away the sand from the beaches in the Odessa City and in the Crimea areas (Fig. 1a).

3.5. Thermophile conditions

The sea surface water temperature (SST) of the Kerch Strait varies from 00C to 2-40C in winter and from 220C to 290C in summer. The minimum average SST of the strait is observed in January and of the bottom layers - in March. In March, the water warm-up starts jointly with seasonal formation of a thermocline in which the gradients are maximum in June. The maximal temperature of the water column is registered in August, when the vertical gradients have slowly disappeared and the water keeps its homogeneity until December (Eremeev V.N. et al., 2003). In the Northern part of the strait (the Opasnoe HMS), the minimum SST of 1.00C is observed in February and the maximum of 24.10C is recorded in July-August (both values are long-term monthly averages, Table 3.5a, Fig. 3.5a). The water seasonal fluctuations are generally typical for shallow water space of the middle-latitude seas.

Table 3.5a. The monthly average water temperature at the surface of the Kerch Strait Northern Part (measured by the Opasnoe HMS), (Eremeev V.N. et al., 2003).

Month												Year
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1.9	1.0	2.5	8.0	15.3	21.1	24.1	24.1	20.1	14.3	9.0	4.6	12.2

Fig. 3.5a. Annual fluctuation of water temperature °C (a) and salinity ‰ (b) averaged for the Kerch Strait water space and shown at the surface (solid line) and the near-bottom (dotted line) layers.

An average sea surface salinity (SSS) of the Strait varies from 14‰ in June to 18.2‰ in January and November. However, the minimal salinity level of the bottom layer is observed in April and October. In January and November salinity does not change from the surface to the bottom layers.

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In the result of the Azov water outflow, the annual average salinity of the Black Sea coastal waters in the proximity of the Kerch Strait remains the lowest for the whole Black Sea being 13.52‰, which is 1.2‰ lower the average salinity level recorded in the North-Western part of the Black Sea, though the latter is strongly influenced by the Danube river run-off, as well as by the Ukrainian large rivers (Dniepr, Dniestr, Southern Bug). In the Kerch Strait Northern part at the entrance to the Azov Sea the water salinity levels could fluctuate in the range of 11.3-18.42‰ within a number of days due to a Black Sea water outflow.

3.6. Water dynamics

The Kerch Strait water exchange with the Black Sea is determined by the wind flows over the strait jointly with the Azov Sea geographical and physical peculiarities. The exchange takes place by means of an effective reciprocal movement through the strait cross-section that results from the water level difference of the Northern (the Azov Sea) and Southern (the Black Sea) parts. The difference in the level depends on the rivers discharge into the Azov Sea and wind flows. The wind flow and stormy winds impact on the sea level is stronger than the rivers influence - on the average 5-6 times and 10-15 times, correspondingly. Thus, winds build-up short-term and the rivers - long-term oscillations of the Azov and Black Seas water exchange.

With the Northern winds prevalence, the strait sea level slopes towards the Black Sea and the so called 'Azov' type flows build-up (Fig.3.6a). The flow velocity increases from 0.1 m/sec to 0.4 m/sec following the waters progressive movement from the Azov Sea to the Northern narrowest part of the Kerch Strait. During those short, high and rapid water flow intrusions, the Northern narrowest part could not release all the accumulating in front of it volumes, and in that case the opposite direction currents build-up in the water bottom layers along the Russian shoreline (back towards the Azov Sea). Simultaneously, the bottom current average velocity may go up to 0.7-0.8 m/sec. Due to the morphological peculiarities of the strait by the Tuzla Island, the water velocity there remains always below 0.4 m/sec. After Tuzla the water flows get wider towards the Black Sea drifting later into the Crimea shoreline direction. The water slows down to 0.1 m/sec before entering the Black Sea.

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Fig. 3.6a. The Kerch Strait water flows impacted by the Northern wind flow (Azov) are given above, and the Southern wind flow (Black Sea) is given below; before construction of the Tuzla dyke (left) and after the construction (right) as observed in autumn 2003.

The water level slopes from the Black to the Azov Sea under the impact of the winds blowing from the South and the so called 'Black Sea' flow type builds-up (Fig. 3.6a). While the flow progresses towards the central part of the Kerch Strait, the sea current velocity increases from 0.1 m/sec to 0.4 m/sec (no more than 0.4 m/sec at Tuzla).

After leaving the Tuzla gully, the Black Sea waters fill in the central part of the Strait. The main stream heads to the North while partially entering the Kerch Bay. The sea current velocity could exceed 0.4 m/sec in the Northern narrowest part, but slows down after it, when entering the

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Azov Sea. Small gyres may appear due to the Kerch Strait and its islands geomorphologic complexity, as well as variability of the wind fields. Those gyres could reach 4-6 km in diameter in the Northern part of the strait, while being of a 1-2 km diameter in its Southern part. The currents velocity could be 0.7–0.8 m/sec in the narrow passes and to average of 0.25-0.3 m/sec. A usual currents velocity does not exceed 0.4–0.5 m/sec, while averaging 0.1–0.3 m/sec in the wider sections (Altman E.N., 1987, Panov B.N., Rubinshtein I.G., 1989 Eremeev V.N. et al., 2003).

The recurrence of the ‘Azov’ flows to the Black Sea average 58% annually and, consequently, the flows from the Black Sea sustain 42%. Under the Northern winds impact, duration of the continuous flows from the Azov Sea could reach 300 hours and impacted by the Southern winds flows from the Black Sea could last for up to 200 hours. Mixed flows could be observed for 6-10 hours on the average. Annually, the ‘Azov’ flows are generated during 208 days in total, the ‘Black Sea’ - 135 days, and mixed flows - 22 days (all the numbers are long-term averages from 1962 till 2006). On the monthly scale, the numbers are 18, 11, and 2 days, respectively.

Serious changes occurred to the Kerch Strait water circulation after the Tuzla dyke construction in 2003 and the sediment formation and abrasion rate were the first to experience the impact. Results of satellite observations over the Kerch Strait flows and visual surveillance conducted over the shoreline dynamics in 2003–2007 have shown that the water flows velocity along the Crimean sea coast increases significantly under the impact of the Northern and North-Eastern winds, since the waters from the Azov Sea are prevented by the dyke from spreading evenly within the strait area (Borovskaya R.V., 2005). As a result, along the coastline from the city of Kerch to the Takil Cape many sand beaches (going by 10-20 m deep into the mainland) were washed away during three years after the dyke construction (2004–2007).

Satellite pictures provide convincing evidences that the Tuzla dyke construction has generally changed water circulation in the Kerch Strait. Under the impact of the Southern winds, the Black Sea water falls into the Taman Bay having passed through the Pavlov Pass only, i.e., through a pit along the Strait (the Tuzla Island – the Chushka Spit) and not through the Tuzla gully. As a result and under the Southern winds impact, a typical cyclone-type circulation (counterclockwise) for the bay area changes into its opposite - an anti-cyclonic, which contributes to accumulation of suspended particles in the bay to eventually result in its silting. In addition, the dyke unfinished construction presents an obstacle for the Black Sea flows and triggers Southern development of reverse flows along the Taman coastline under the Southern winds impact, as well as a local anti-cyclonic gyre build-up in the strait Southern part (from the Black Sea side of the dyke).

3.7. Water exchange between the Black and Azov Seas

According to the annual average long-term data from 1923 till 1985, the water flow from the Azov to the Black Sea through the Kerch Strait is 49.8 cub km/year having a maximum of 71.2 cub km/year (142% of the average were observed in 1979) and a minimum of 35.2 cub km/year (71% of the average were observed in 1973). The water flow from the Black Sea averages 33.4 cub

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km and varies from 20.6 cub km registered in 1923 to 46.3 cub km/year reached in 1949, i.e., from 63% to 138% of the long-term annual average, respectively. The produced water exchange is directed from the Azov to the Black Sea and averagely sustains 16.4 cub km/year, while its maximum of 48.8 cub km was reached in 1932 and the minimum of 2.0 cub km was registered in 1973. The reached maximum sustained 299% of the annual average (Altman E.N., 1987, Ilyin Yu.P, Lipchenko M.M., Dyakov N.N., 2003).

The water volumes discharged from the Black to the Azov Sea are most often larger (Simonov A.I., Altman E.N., 1991), except for spring (March-May) when the situation becomes different: discharges from the Azov to the Black Sea become prevalent (340–860 m3/sec). This phenomenon is caused by regime of the two main rivers falling into the Azov Sea, being the Don and the Cuban. Jointly with the winds they play an important role in generating sea currents during the spring time, while the rivers high waters increase velocity of the currents from the Azov to the Black Sea. Furthermore, due to the flows higher frequency from the Azov to the Black Sea, the annually prevailing currents direction is from the Azov Sea bringing, as a result, 12-14 cub km/year of Azov water to the Black Sea on the yearly basis, calculated on data from 1923 till 1999 (Eremeev V.N. et al., 2003).

A stable slowdown of the outflow from the Azov to the Black Sea was observed from 1912 to 1975, when the Azov Sea water balance sustained 28.6; 22.3; 10.6 and 5.5 cub km/year for the periods of 1912–1922; 1941–1945; 1966–1975; and 1971–1975, accordingly (Remizova S.S., 1984). Based on the recent field observations available (data collected by the Opasnoe HMS), an annual average discharge from the Black Sea registered in the Northern part of the Kerch Strait sustains 3,900 m3/sec, while the Azov Sea discharge sustains 3,500 m3/sec.

Still, the resulting flow is directed from the Azov to the Black Sea to sustain around 12 cub km/year considering the flow annual average frequency. The resulting flow estimation deriving from the Azov sea water balance equation for the period after the rivers overregulation gives a slightly higher number of about 14 cub km/year, while its fluctuations mainly depend upon the Don and Cuban rivers decreased water discharge (Table 3.7a), (Eremeev V.N. et al., 2003).

Table 3.7a. The Azov Sea fresh-water balance and the resulting flow through the Kerch Strait (Eremeev V.N. et al., 2003).

Period of averaging	1923-1998	1923-1950	1951-1998	Changes
Rivers discharge, cub km	36.5	40.5	34.7	-5.8
Precipitation, cub km	15.2	15.0	15.3	+0.3
Evaporation, cub km	33.0	33.3	32.9	-0.4
Resulting flow through the Kerch Strait, cub km	16.2	20.5	14.2	-6.3

3.8. Fluctuations of the sea level

The Kerch Strait sea level fluctuations vary by nature. The most significant in terms of their impact are the wind driven downward and upward fluctuations, while the seasonal and climatic-scope fluctuations produce the reasonably smaller amplitudes. Annually the sea level fluctuations in the Kerch Strait demonstrate a well expressed seasonal variability to reach the

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maximum in June and the minimum – in October. The span of those seasonal fluctuations roughly reaches 25 cm. The biggest through the year sea level changes could be registered in January-February in the Northern part of the Strait, while in its Southern part – in February-March and they are triggered by a strong sea storm activity in those places during the mentioned months. The smallest sea level changes in the Kerch Strait could be observed in August-September (Eremeev V.N. et al., 2003).

The sea level long-term fluctuations are largely related to the changes in discharge from the rivers of the Azov-Black Sea basin and substantially exceed their seasonal parameters to reach 35-40 cm. Generally, the year-to-year fluctuations experienced by the Azov-Black Sea basin show a stable tendency of increase (1.4 - 1.7 mm/year).

Winds are the main reason for the Kerch Strait sea level meso-scale fluctuations. Their produced downward and upward fluctuations affect the sea level smooth seasonal changes through exceeding their average amplitude by 5-6 times, while reaching 8-10 times when the storm is very strong. Downward and upward fluctuations are the most often observed in the Kerch Strait Northern part under the impact of the North-Eastern wind having the highest frequency, strength and duration. On the Strait, the most dangerous conditions for the catastrophic sea level rises in such synoptic situations are those, when the Northern winds blow at the Azov Sea Northern coast, the North-Western winds – at the North-Western coast and the Western winds – at the South of the sea. The Northern narrowest part of the Kerch Strait is the border for expansion of the sea level disturbance produced by the Azov Sea downward and upward fluctuations. The Strait part to the South is affected by the Black Sea level changes. It’s worth mentioning that under the impact of extreme upward fluctuations - that happen nearly once in 50 years - large parts of the Tuzla Spit could be over flooded. Energy generated by high waves in the course of the upward fluctuations is well known to be crucial for erosion of the Kerch Strait accumulative formations (Eremeev V.N. et al., 2003).

3.9. Ice coverage

The Kerch strait freezes every year. However, the ice cover appears late and it is thinner on the Strait than at the Azov Sea due to the influence of the warmer waters coming from the Black Sea.

KERCH-310106-PNM- running off the Port Krim-01

Photo: The Kerch Strait in winter 2006, by Michael Khmelkov.

A standard practice for the winter type classification (mild, moderate and severe) is applied for the ice conditions analysis through taking into consideration the total sum of the daily air temperatures above the sea level during the icy seasons. The ice-condition main characteristics including specific dates and the ice coverage duration in the Kerch Strait Northern part (counted dependant on the winter type) are given in Table 3.9a (Eremeev V.N. et al., 2003).

Statistically, based on the Opasnoe HMS long-term observations that have an 80% probability, the ice cover formation starts on the Kerch Strait on 11 January. This ice formation date could vary from 1 to 30 January depending upon a severe or mild winter, accordingly. During the moderate and mild winters, complete ice cover on the strait does not occur, while it may happen by 20 January during severe winters. Still, solid and continuous ice cover appears in the strait Northern part up to the Tuzla Island only, and the thickness of the fast shore ice could be of 10 cm in the Kerch inlet. Ice is usually more solid on the Taman Bay and could be 30 cm thick reaching up to 65 cm during severe winters. Ice there is mainly of local origin. It occurs in mid- or late December and forms a fixed solid stable cover during the first decade of January. The Taman Bay is not covered with ice all-over. Complete ice melting with probability of 80% happens around 8 March. It may happen three weeks later (29 March) during a severe winter or two weeks earlier (23 February), if the winter is mild.

Table 3.9a. Average dates and probability (P, %) of ice phenomena on the Kerch Strait for the period of 1944-2003 (the Opasnoe HMS), (Eremeev V.N. et al., 2003).

Ice phenomena	Winter type						Average	
	Severe		Moderate		Mild			
	Date	P	Date	P	Date	P	Date	P
First ice formation	01.01	100	03.01	100	30.01	57	11.01	80
Stable ice formation	12.01	100	13.01	65	23.01	18	14.01	49
Beginning of a fast-shore ice formation	15.01	82	09.01	40	17.01	11	12.01	34
First complete freezing	13.01	91	20.01	80	27.01	14	18.01	51
Final freezing	20.01	27	-	5	-	0	28.01	7
Beginning of the fast-shore ice breaking	25.02	73	06.02	35	02.02	7	14.02	29
End of the fast-shore ice breaking	10.03	100	24.02	95	18.02	29	27.02	64
Final ice free	29.03	100	07.03	100	23.02	57	08.03	80

Sometimes in winter the Strait recurrent re-opening and freezing could happen. For example, with the North-Eastern winds and severe frosts arriving, the Strait starts acquiring relatively solid ice coverage, while with the Southern winds blowing it could become free from solid ice quite fast.

Strong Northern and North-Eastern winds build-up large accumulations of cohesive and hummocky ice (up to 4 points by the 5-point scale) at the strait Northern entrance that impede the navigation. Due to the ice potential sliding, the most dangerous for the strait navigation in winter is the turn from the Chushka to the Camush-Burun ranges, the Zerkovnaya bank area, and the North-Eastern end of the Tuzla Island (Eremeev V.N. et al., 2003).

KERCH-310106-PNM-Entrance to the Port Krim-01

Photo: The entrance to the Port of Crimea in winter 2006, by Michael Khmelkov.

The winter 2008 was abnormally cold, similar to 2006, and the Azov Sea got covered by ice with thickness of 35-45 cm. In port Caucasus the ice was 5-10 cm. In January 2008 the air temperatures were among the lowest observed since 1891 in the area – below -23°C and often the weather was stormy with low visibility in the sea. Presently, there are no technologies of oil spill response in waters covered with ice.

3.10. Evolution and movement of the Tuzla Island sediment

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well present in the coastal zone, and *Labridae* - occasionally. The marine boreal species sub-group consists of six species and subspecies: inhabiting the Azov Sea permanently are the Azov sea turbot (*Psetta torosa*), the Black Sea flounder, three-spine stickleback (*Gasterosteus aculeatus*), and a relatively rare Black Sea turbot (*Psetta maeotica*) and the Black Sea whiting (*Merlangius euxinus*). Occasionally, a considerable number of the Black Sea sprats (*Sprattus sprattus*) may be caught by a pound net. Marine species group also includes the Far Eastern haarder (*Liza haematocheila*) deliberately introduced into the Azov and Black Seas from the Far Eastern region.

The brackish-water fishes form a special group of the Azov Sea fauna (11 species and sub-species) constantly dwelling in the basin. They are the Ponto-Caspian relicts, i.e., the brackish fauna "fragments" originating from the Pliocene Pontic Sea-lake. The Pelagic Azov Sea sprat (*Clupeonella cultriventris cultriventris*) is most popular among the sub-species. Within this group, the best presented is the *Gobiidae* family consisting of nine species with round goby (*Neogobius melanostomus*) among them which is the most frequently present and accounts for the highest recorded numbers in catches. Occasionally, the Azov perkarina (*Percarina maeotica*) could be detected in small quantities.

Eight species of migratory fish, mostly anadromous, are present, and they spawn in the rivers and fatten in the sea. This group includes catadromous eel (*Anguilla anguilla*) as well. Almost all the migratory fish has commercial importance. Overfishing and negative anthropogenic impact have resulted in the fish populations currently catastrophic situation status. This primarily concerns great sturgeon (Huso huso), i.e., the Russian (*Acipenser gueldenstaedti*) and starred (*A. stellatus*) sturgeon, the Azov shemaya (*Alburnus mento*), relatively rare vimba bream (*Vimba vimba*), as well as migratory shads (gen. *Alosa*).

A group of semi-migratory fish consists of seven species, mainly from the Cyprinidae family: bream (*Abramis brama*), common carp (*Cyprinus carpio*), Prussian carp (Carassius *gibelio*), ziege (*Pelecus cultratus*), saber fish (*Rutilus rutilus heckeli*), wells catfish (*Silurus glanis*) and pikeperch (*Stizostedion lucioperca*). These species may be detected in the Kerch Strait front area, though, sporadically.

Freshwater fishes may be in small numbers detected in catches mostly during the river discharges increase. The following belong to two families and six species: Cyprinidae, i.e., rudd (*Scardinius erytrophthalmus*), grass carp (*Ctenopharyngodon idella*), and carp (*Cyprinus carpio*); Percidae, i.e., European perch (*Perca fluviatilis*), Don ruffe (*Acerina acerina*); and Esocidae, i.e., Northern pike (*Esox lucius*).

No serious changes were witnessed in structure of the coastal fish communities inhabiting the Cazantip and Arabatskiy Bays that could be directly linked to the Kerch Strait oil spill accident.

RU: AzNIIRKH. January-December 2008

There were different programs conducted by AzNIIRKH in 2008 to produce materials for the biological communities condition status assessment within the Kerch Strait, and the Azov and

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