



EXPERIENCES OF RUSSIAN ARCTIC NAVIGATION

Nataliya Marchenko^{1, 2, 3}

¹ The University Centre in Svalbard, Longyearbyen, Norway

² The Norwegian University of Science and Technology, Department of Civil and Transport Engineering, Trondheim, Norway

³ State Oceanographic Institute, Moscow, Russia

ABSTRACT

Shipping in the Arctic seas has a long history and it's own features. For a modern development of the operation in the northern seas it is very important to learn from the previous ice pilot experiences. PetroArctic project has gathered the information about Russian activities in the Arctic. First part of the research is a description of the five Russian Arctic Seas from the navigation point of view. Both common and unique features for each of the seas are under consideration. Trends in the development of the ships (materials and means of a stronger hull form) and navigation (preferable routes and time) have been deduced.

Appreciable amount of written documentation and interviews with actual persons involved were processed. Information about extreme situations (ice drift and ice jet, icing and hummocking, ridging ice opening and closing) and special weather and ice conditions were collected from the sailors and ice pilots. Items of special interest were connected to the shipwrecks and other accidents.

Data about vessel type, location and time of wrecks and damages, weather and ice conditions, description of events has been organized into a data base. For many accidents information on distinguished features and the behaviour of humans in the Arctic waters (reactions in stressful situations and reasons for deaths) has been collected. The most original part of presented investigation is the set of maps for each sea where many of the accidents (date, location, vessels etc) are shown. For example for Kara Sea it was possible to present more than 40 accidents, among them 29 that happened in heavy ice conditions. In most cases the crew was saved, but there are also several episodes with lethal outcome.

HISTORY

Early history

Russian sailors have for many centuries experienced the navigation in the ice conditions. This history begun as early as the 12th century, when the explorers from Novgorod entered the White Sea through the Northern Dvina and Onega estuaries and founded settlements along the sea coasts: Kholmogory, Arkhangelsk, Kola. This was connected with the expansion of the sea trade and development of the new territories. As seafarers the pomors (inhabitants of Russian North) dominated an enormous zone from the shore areas of White, Barents and Kara sea to the archipelagos of New Land and Spitsbergen. In the 16th century the Russian Arctic seafaring became particularly active. During this period five main sea routes were set up: 1) to and along the shore of Norway, 2) to the northern island of Novaya Zemlya

Archipelago, 3) Mangazeya sea path to the northern part of West Siberia, 4) toward the mouth of the river Yenisei, 5) so called Grumant route to Spitsbergen (Starkov, 2001). All these routes included the whole system of navigation support: a rational shortcut route, optimal start time of a voyage, onshore support signs (like this cross), usage of special types of ships and sailing directions and availability of the transitional sea ports in case of a forced wintering. One of the major factors which allowed pomors to overcome the difficult and challenging Arctic routes was the usage of specialized ships. For the different routes the pomors used different types of vessels, adjusted for the specific conditions. In general, koches of pomors were of two basic types - large for the coastal voyages and small for the navigation in open seas with ice. Because of its additional skin-planking (called *kotsa*) and Arctic design of the body and the rudder, it could sail without being damaged in the waters full of ice blocks and ice floes. The koch was a unique ship of its class for several centuries.

The pomors epoch went by, but it gave us the ship construction and the sailor experience. The idea of a walnut-shell shaped ship hull was used by F. Nansen for his *Fram*. Due to this rounded hull shape and forced boards *Fram* endured awful ice stresses and nipping. Further history of the exploration of Russian Arctic was full of heroic and dramatic events. The most dramatic was year 1912 when three Russian expeditions headed for the Arctic. Expedition led by lieutenant Georgii Sedov on *Svyatoi Foka* directed to North Pole, schooners *Svyataya Anna* (with lieutenant Georgii Brusilov on the head) and *Gerkules* (Rusanov's) planned to go through Northeast Passage. All of them were unsuccessful and only *Svyatoi Foka* managed to come back with great difficulties.

The more optimistic pages of the history were connected to the icebreakers. North sea route mastering had got new possibilities in 29. October 1898 by launching the first true icebreaker *Yermak*. She had a strengthened hull shaped to ride over and crush pack ice (up to 2 m thick) and on the very first voyage she reached 81°21'N north of Spitsbergen in 1899.

XX century. Northern Sea Route mastering and scientific expeditions.

New era of using Russian Arctic sea routes commercially began in 1920 with so called Siberian Bread Expedition (Sibirskaya Khlebnaya Ekspeditsiya), followed by Trade Kara operations (1921-1939) connecting southern Siberia with northern Europe (Belov, 1959, 1969). In 1932 a Soviet expedition led by O.Y. Schmidt on the icebreaking steamer *Sibiriyakov* (master V.I. Voronin) was the first to sail all the way from Arkhangelsk to the Bering Strait in the same summer without wintering en route. After a couple of more trial runs in 1933 and 1934, the Northern Sea Route was officially opened and commercial exploitation began in 1935. In 1978 a year round operation on route Murmansk – Dudinka was started to transport the enriched nickel and copper from Norilsk to Murmansk by the sea and then to Monchegorsk enrichment plant. NSR blossomed in 1987 when turnover reached 6.85 ml.t. 16 icebreakers (8 nuclear, 8 diesel) and 380 transport vessels worked in the Arctic (Problemy..., 2006). In 1989 the number of icebreakers reached 18, accompanied by Arctic lighter *Sevmorput*, 20 ice class vessels and 108 freighters.

During all these years Russian sailors accumulated extremely impressive skills for the operations in the Arctic waters. The experiences of the Russian ice pilots were summarized in the special textbooks for the future captains. There are at least 9 such textbooks written by captains who took part in the Northern Sea Route cruises (for example, Arikaynen, Chubakov, 1987, Gotskiy, 1957). The first such textbook was published in 1940. Key points of the Russian Arctic history and specifics of the seas are well known to the foreign society and researchers as well as it was presented in articles by Terence Armstrong (Armstrong, 1952, 1983) and William Barr with co-author (Barr, 1974-1985), working papers of INSROP (International Northern Sea Route Programme, June 1993 – March 1999), CRREL (Cold

Region Research and Engineering Laboratory) reports and others. The translations introduced western audience to the most important and dramatic pages of the NSR history, such as, for example, the cruise of *Sv. Anna* and Al'banov's sledge journey (Barr, 1975,1978), the Rusanov's *Gerkules* expedition in the Kara Sea in 1913 (Barr,1984); the drift of Lenin's convoy in the Laptev Sea in 1937-1938 (Barr, 1980) and the shipping crisis in the eastern Arctic at the close of the 1983 navigation (Barr, Wilson, 1985). However, some pages of this heroic epic are not known even in Russia. The investigation of the Russian ice pilot experience has become very relevant nowadays in the light of new activities in oil-gas exploration spreading out in the Arctic and the new transportation possibilities appearing due to the global warming.

INVESTIGATION OF ACCIDENTS IN ARCTIC

The objectives

The objective of this investigation is to increase the knowledge about the Arctic/ cold climate conditions for safe and sound hydrocarbons production and transport from the Arctic region. The main aim is a sustainable development and exploitation of the Arctic region. The collection of the ice pilot experiences is a mixture of history, geography, technology and sometimes psychology. The research could prove useful even in the modern age of detailed satellite images, special programs, mathematical models and maps of ice conditions because it shows us how a man would feel and act in the extreme conditions. We have to know how people operate in the Arctic and how they solve difficult tasks. The investigation presented in this article is devoted mainly to the accidents induced by the natural causes in the Arctic since 1900. A detailed description of such accidents can give us not only great examples of a heroic behaviour, but also provide information on natural, weather and ice conditions and show special techniques used by crew to survive.

Drift of schooner Sv Anna (1912-1914) and discovering of Vize Island and Sv. Anna Trough (1930)

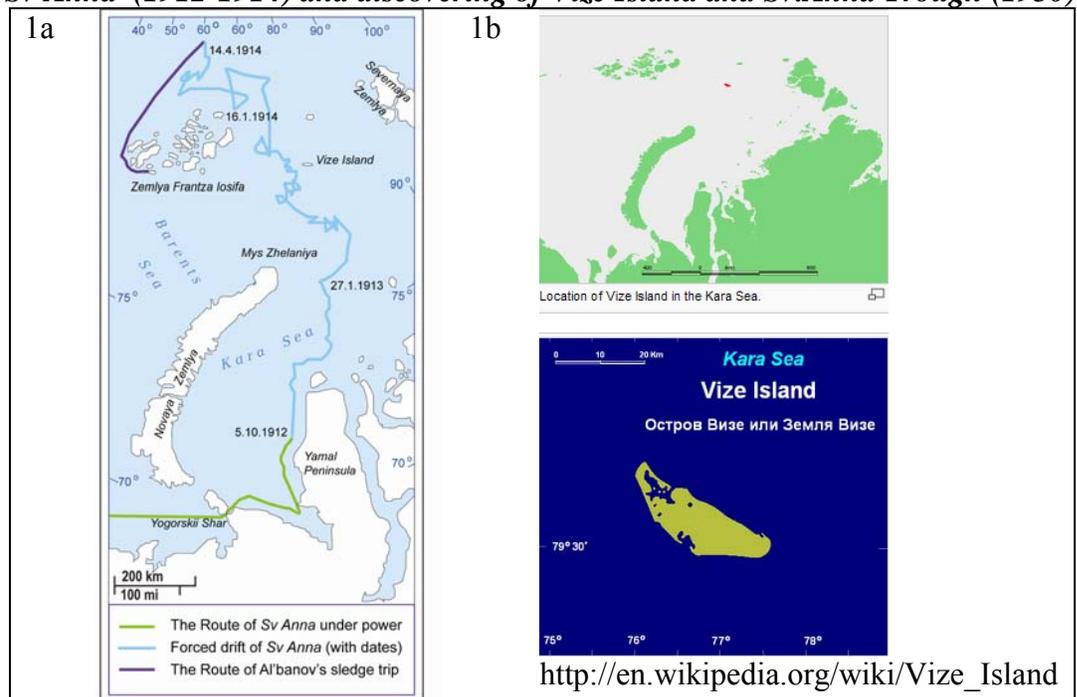


Figure 1. Drift of schooner *Sv Anna* (1a) and location of Vize Island (1b)

In the summer of 1912 G.L.Brusilov mounted an expedition to traverse the Northern Sea Route. But his schooner *Svyataya Anna* [Saint Anna] was caught by the ice near Yamal Peninsula and drifted helplessly to the north at least till April 1914. In April 1914 eleven of her crew, led by navigation officer V.I.Albanov, left the ship at 110 km north of Franz Josef Land and nothing is known about Sv Anna after that. Albanov’s team tried to reach the land, but only two of them survived. They brought a copy of the ship’s journal to St Petersburg. In 1924, Russian oceanographer V.Yu.Vize studied the drift of *Svyataya Anna* by this journal. He detected an odd deviation of the path of the ship's drift caused by certain variations of the patterns of the sea and ice currents. He deemed that the deviation was caused by the presence of an undiscovered island whose coordinates he was able to calculate with precision thanks to the availability of the successive positions of the St. Anna during its drift. Finally, the island was discovered on 13. August 1930 by a Soviet expedition aboard the icebreaker *Sedov* (captain V.Voronin) The Island was named after Professor Vize who was at the time aboard the *Sedov* and who was able to set foot on the island whose existence he had predicted. The other scientific result derived from the ship journal is the discovery of St.Anna Trough.

Rescue of icebreaker Admiral Lazarev (1965)

Several ships almost crushed by the ice have been saved from sinking by skilful and self-sacrificing actions of the crew. Among them were the freighters *Kolya Myagotin* (1983 Chukchi sea) (Barr, 1985) and *Iosif Stalin* (1937 Laptev Sea) (Barr, 1980). Another example is the rescue of the icebreaker *Admiral Lazarev* in East-Siberian Sea, which showed that even a powerful icebreaker could be helpless against the ice, but courage and gumption could save the ship.

17.-18. August 1965 the icebreaker *Admiral Lasarev* was seriously damaged by the ice to the west from Aion Island. (Abonosimov, 2002)

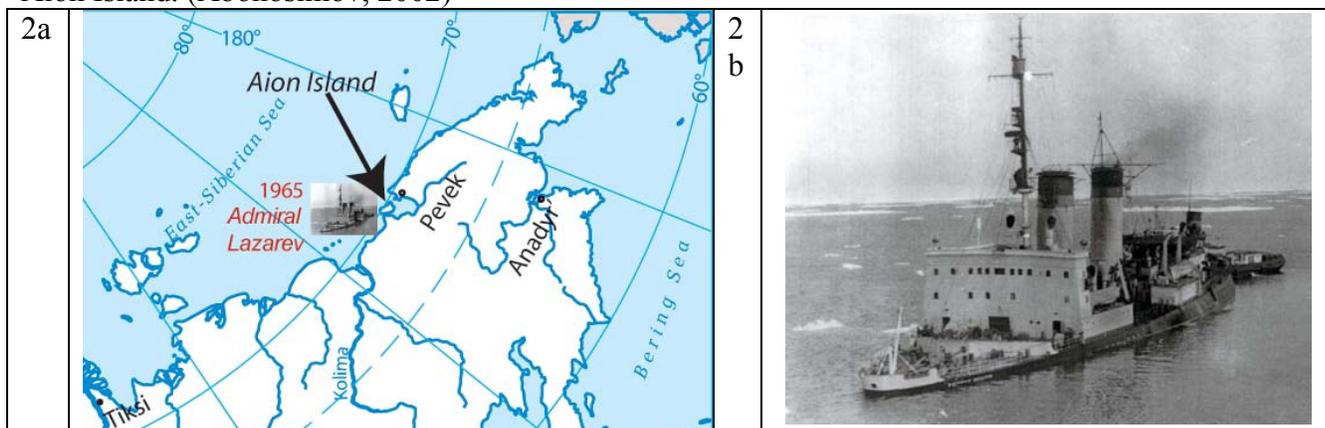


Figure 2. Accident with icebreaker *Admiral Lazarev*: location (2a) and photo (2b).

Photo:<http://ntic.msun.ru/ntic/exhibition/fesco/book/fesco-125.pdf>

Two huge ice-floats appeared suddenly in the fog at 3.30 on the 17. August 1965, impossible to see until it was too late to turn. The icebreaker endured (faced out) the first hit, but was cast back to the other side. There the other ice-floe was waiting for her. The float cut the bottom of ice-breaker like a great saw. The master V.T.Sadchikov decided to put the vessel to the shallow water and after several hours she sank at the point with coordinates 70°03'48" north and 168°52'30" east. The depth was 12 m and there were only 20 centimeters spared to cover icebreaker with water.

Freighter *Amguema*, towboat *Donets*, icebreakers № 5 and *Leningrad* came to help soon. Struggle for the survival of the famous icebreaker began. Three of four stokeholds were waterlogged. In the fourth

stokehold the sailors worked up to their middle in the water. Three divers from the icebreaker *Leningrad* welded the 6-m hole in the dark cold water. On the next day the powerful pumps removed the water from the icebreaker. The icebreaker *Leningrad* towed *Admiral Lasarev* to port Pevek.

“Discovering by own boards”

There is a very name worthy chapter “Discovering by own boards” in the book devoted to the history of Arctic hydrography “Autographs on the map” (Popov, 1990). This chapter is about accidents with survey vessels, which blundered their way along Arctic coastline putting it on the map. They often crushed in bad weather condition, stranded on unknown shallows, banks and rocks. And now we have very detailed maps and their names on these maps. According to Popov there are at least 165 geographical names after vessels on the Arctic map, 102 names from them devoted to survey and expedition vessels. These are, for example, in Kara sea - Saint Anna Trough (after mentioned above schooner *Svyataya Anna* - 1914), Zveroboi Bank (Survey vessel *Zveroboi* sank in 1929) and Vaigach Rock (Icebreaker *Vaigach* sank in 1918).

SEAMEN EXPERIENCES AND ACCIDENTS DATA BASE

Accident classification. Ice jets.

For our purposes we can divide all the accidents into two main groups: with ice or without ice. There are four main groups among the accidents in the ice conditions. These are forced drift, forced overwintering, shipwrecks and serious ice damage, when the crew has managed to rescue the ship with the help of other vessels. Among the accidents without the ice we can distinguish shipwrecks and serious damage.

All these types of accidents are quite received and understandable. But there is a special case of forced drift deserving of particular attention, as this is not very common in the international science literature. This is so called ice jet, the forced drift with considerable speed. Ice flow in ice jet is so powerful that even the modern icebreakers can not resist it. This phenomenon has been described by the chief of Headquarters for East Sector of Northern Sea Route in Pevek V.Kupetskii (Kupetskii, 1983) and modeled and mathematically presented by V. Benzeman (1983).

V.Benzeman (2004) determined “ice jet” as especially dangerous ice phenomenon – extreme ice drift in the boundary stream flow in strongly over layered sea, creating the effect of “a pure slide” in the layer of density shift and storm surge effect near boundary of compact ice and fast ice. Ice jet displays itself as a drift with huge speed and has lead to shipwrecks several times, *Nina Sagaidak* for example.

V.Kupetskii devoted a chapter “Ice jets of high latitudes” in his book “We will come back to the Arctic” (Kupetskii, 2004) to this phenomenon. Describing the ice jet he cited the spectator: “...the huge blocks of ice collided and turned around in unconceivable jumble. It was horrible. It was the desperation, terrible squash, ice hell the best illustration for the last day” . The rush drift of different forms and ages of the ice arises by the storm surge along the obstacles in some narrow places such as the straits, near the islands and capes. Ice jets are common in the back parts of cyclones with lasting and strong west and north-west winds. They are the most dangerous at the beginning of an intensive freezing up, when young ice can push the vessel up to the shallow.

At the beginning of November 1967 a thick young ice lifted up on the 15m high cliff of Aion Island and reached the residential building of the polar station. After the fast ice formation, nearly one month after the beginning of the freezing, ice jet went along the fats ice, which prevented the grounding of the vessels. During times like this the most dangerous events are the collisions of the ships which are almost uncontrollable and unable to resist the ice drift. The shipwreck of freighter *Nina Sagaidak* near Kosa Dvuh Pilotov in Chukchi Sea, October 1983 is a great example. Before she sank, she was slammed to the freighter *Kamenesk-Ural'skii*, while they drifted helplessly apart (see also, Barr, 1985).

Ice drift can be so fast that it is visible from the airplanes. It has happened several times to the east of Vrangeli Island, near north-west Aion, Mys Schmidta, Mys Ual'kal' in Gulf Kresta. By satellite image one can find the ice jet near Bering Strait in Chukchi Sea at the second part of the winter. Ice jets could be so visible that inexperienced prospectors can mix them up with an icebreaker trace (Kupetskii, 1983).

KARA SEA EXAMPLE

As an illustration of the "Accidents data base" the short extraction of Kara Sea is presented here. The example includes only a chapter about accidents with the ice, a short description in the form of a table were only the essential sources in Russian and in English are listed. On the map (figure 3) the locations of accidents are shown. It should be stated that the ice drift has usually very complicated and chaotic configuration and only the main direction without any loops and zigzags is presented on this map.

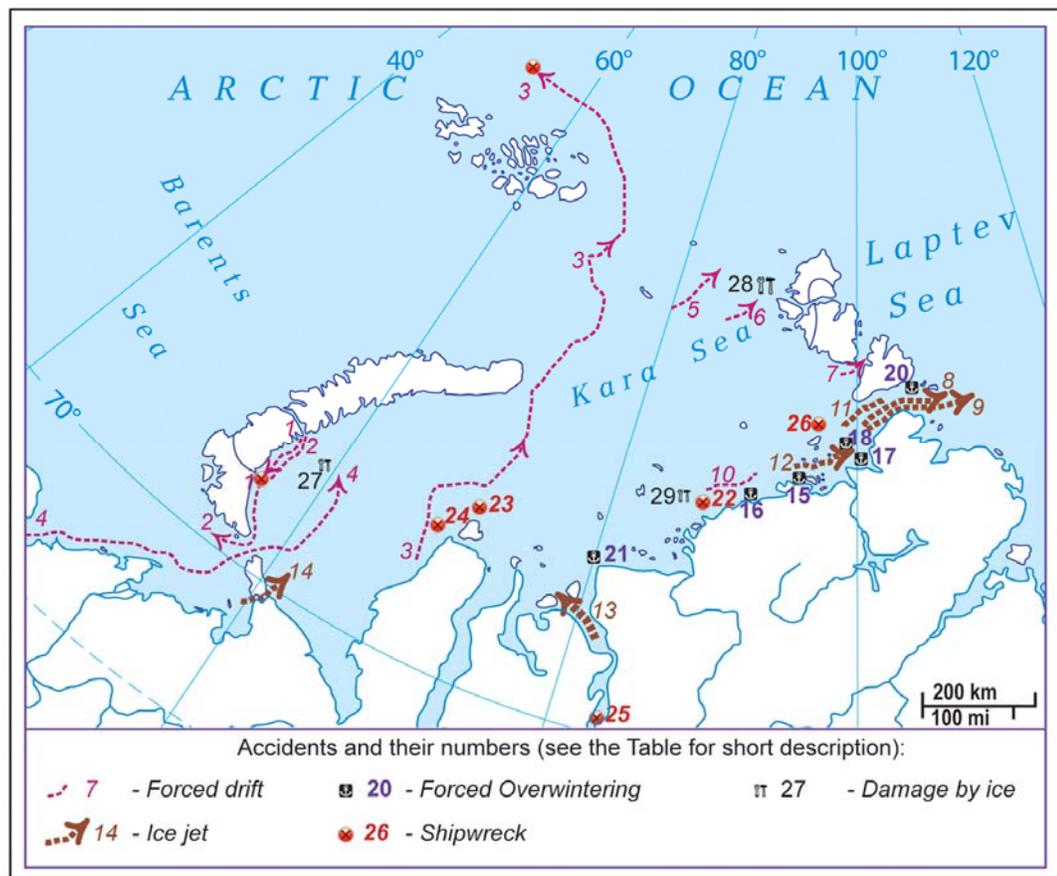


Figure 3. Accidents in Kara Sea since 1900, induced by ice conditions.

Table. Short description of accidents in Kara Sea since 1900, induced by ice conditions.

№	Short description	References
	<i>Forced drift with ice - 14</i>	
1	1900. September- October. Wooden yacht <i>Mechta</i> (led by A.A.Borisov). Forced drift with ice along the east coast of South Island Novaya Zemlya since the end of September. The crew left her at 10. October 1900 and walked and swam through the ice, reached the land near the mouth of Savina River, crossed Novaya Zemlya and arrived to Pomorskaya Guba at 12. November 1900.	Vize, 1948
2	1907. July- August. Research vessel, originally built for whaling, <i>Belgica</i> (led by Philippe duke d'Orléans). Nipped by the ice in Matochkin Shar at the end of July. Current carried her with the ice to the south and drove upon Barents Sea through Kara Gate (16. August 1907), saved by herself.	Vize, 1948
3	1912-1914. Wooden schooner <i>Svyataya Anna</i> (captain Brusilov). The ship became beset just west to Yamal Peninsula in October 1912 and drifted steadily northward in the ice. By April 1914 she was still drifting 100 km north of Franz Josef Land and further to the north - Evidently wrecked - Crew dead, except for 2 men who managed to reach Franz Josef Land.	Vize, 1948 Barr, 1978
4	1920. January- June. Steamer <i>Solovey Budimirovich</i> (later recalled to <i>Malygin</i>). Forced drift from Cheshskaya Guba to Kara Sea during 6 months. Saved by icebreakers <i>Canada</i> and <i>Svyatogor</i> (19. June 1920).	Bolotnikov, 1941 Belov, 1959
5	1930. August. Icebreaking steamer <i>Sedov</i> . Drifted helplessly for 7 days to the east of Vize Island, saved by herself.	Vize, 1948
6	1934. Icebreaking steamer <i>Sadko</i> . On the way from Vize Island to Domashnii Island <i>Sadko</i> was nipped by the heavy ice and only managed to emerge after 23 days of drifting.	Vize, 1948
7	1936. Icebreaking steamer <i>Sibiryakov</i> . She was caught by the ice at an entrance to Shokal'skii Strait and drifted 28 days, saved by icebreaking steamer <i>Yermak</i>	Vize, 1948
8	1937. August. Icebreaking steamer <i>Sadko</i> . Nipped by the ice, turned and moved back for several days with the speed 1 mile per hour through the Vilkiskiy Strait, saved by herself.	Nikolaeva, Khromtsova, 1980
9	1937. September. The whole caravan of vessels with icebreaker <i>Yermak</i> on the head was carried by the ice stream from Kara sea through Vilkiskii Strait with a huge speed. They were popped out as a cork to the Laptev Sea.	Nikolaeva, Khromtsova, 1980
10	1937. Summer. Research vessel <i>Professor Vize</i> . Drifted for several weeks near the coast by Khariton Laptev, saved by herself.	Vize, 1948
11	1963. October. Caravan of vessels with icebreaker <i>Lenin</i> in the young nilas ice was overtaken by the western storm winds on approach to the Vilkiskii Strait. Fields of young ice (5cm thick), compressed and layered by wind, immediately and strongly speeded off the movement. The caravan mired in ice-nilas "porridge", stuck by the huge pillow of ice. The icebreaker alternately dragged out the vessels from ice stall off the shore to the open water.	Kupetskiy, 1983
12	1963. October. Steamer <i>Novovoronezh</i> . Having lost her screw earlier, she was pulled through all Nordenskjold Archipelago by the ice jet. <i>Novovoronezh</i> passed safely past islands and shallows and touched none of these obstacles.	Kupetskiy, 1983

13	1977. November. Icebreaker <i>Captain Sorokin</i> . Forced drift through Yenisei Gulf due to the ice with great speed (ice jet).	Benzeman, 2004
14	1980. March-April. 2 nuclear icebreakers <i>Sibir'</i> , <i>Arktika</i> and icebreaker <i>Kiev</i> . Forced drift due to the ice with great speed (ice jet) through the Ugorskii shar Strait.	Benzeman, 2004
	Forced overwintering – 7	
15	26. September 1900 – 30. August 1901. <i>Zarya</i> . “Ice Captivity” in Kolin Archer Bay on Nansen Island 76°08' north and 95°04' east. Crew and the scientific staff carried out geographical investigation and sledge voyages.	Vize, 1948
16	12. September 1914- 11. August 1915. <i>Eklips</i> (led by O.Sverdrup). Overwintering near Mys Vilda 75°39' north and 91°26' east	Pinkhenson, 1962. Barr, 1974
17	9. September 1914 – 2. August 1915. Icebreaking steamer <i>Taymyr</i> . <i>Taymyr</i> was caught between two large ice fields pivoting around each other and was severely nipped. She suffered heavy damage and the crew was ready to abandon the ship.	Pinkhenson, 1962. Barr, 1974
18	9. September 1914 – 2. August 1915. Icebreaking steamer <i>Vaygach</i> . <i>Vaygach</i> was also nipped by the ice several times, but was not damaged.	Pinkhneson, 1962_. Barr, 1974
19	Autumn 1936 – summer 1937. Survey vessel <i>Toros</i> . She was not able to pass the heavy ice on the way to Laptev sea and was set safely for induced overwintering in Nordenskjold Archipelago. Regular hydrographical investigations and meteorological observations were undertaken.	Popov, 1990
20	October 1937 – June 1938. Almost half of the transport vessels (26 ships) and the entire icebreaker fleet (3 icebreakers and 4 icebreaker steamers) overwintered in the Arctic. <i>Litke</i> , <i>Mossovet</i> , <i>Uriskiy</i> , <i>Pravda</i> , <i>Krest'yanka</i> , <i>Molokov</i> were beset at the south- east cost of Bol'shevik Island.	Vize, 1948
21	October 1937 – June 1938. 6 cargo ships with timber overwintered near Dikson Island.	Vize, 1948
	Shipwreck - 5	
22	1912. Sealing ship <i>Gerkules</i> (led by V.Rusanov). In late August <i>Gerkules</i> headed east for Novaya Zemlya and tried to go through the Northeast Passage. Neither ship nor the crew (15 members) were seen again. The relics of the expedition have been found in several places on the island Popov-Chykhchin, Primetnii, Gerkules and the neighboring islands in Shkhery Minina near Bereg Kharitona Lapteva.	Pinkhenson, 1962. Barr, 1984
23	1921. 17. September. Steamer <i>Enisey</i> . 73°35' north and 70°42' east. Moving in very open ice <i>Enisey</i> collided with a small floe berg, got a hole and sank after 17 minutes. Crew was saved by the icebreaker <i>Sedov</i> .	Belov, 1959
24	1921. 20. September. Steamer <i>Ob'</i> . 72°38' north and 66° east. At 17. September <i>Ob'</i> got a hole after a strong hit by the ice, drifted to north-east with a bad list to a starboard and sank at 20. September. Crew was saved by the icebreaker <i>Mayigin</i> .	Belov, 1959

25	1924. Schooner <i>Agnessa</i> . Crushed by the stream-ice in a lower reaches of River Yenisei.	Belov, 1959
26	1985. June. Freighter <i>Nina Kuroverova</i> . Butt weld below water line burst up under ice pressure near Vilkiskii Strait. Two fore holds filled up with the water very fast and she sank. Crew was saved by the icebreaker <i>Lenin</i> .	Gerasimov, 2006
	Damage by ice - 3	
27	1933. August. Steamer <i>Cheluskin</i> . In the ice with compactness 4-6 ball, <i>Cheluskin</i> got damaged seriously. The foreship was leaking badly, 12 bulkheads were damaged, 33 rivets were cut away and there were also 4 deep dents. To lift the damaged places above the waterline, the ship was unloaded with help of icebreaker <i>Krasin</i> . After reparations <i>Krasin</i> led <i>Cheluskin</i> through the ice. But as <i>Cheluskin</i> was wider than <i>Krasin</i> , she got a new dent. <i>Cheluskin</i> was famous worldwide for half a year. She was drifting with the ice field from October 1933 till sinking on 13. February 1934, crushed by the icepacks in the Chukchi Sea. The crew managed to escape onto the ice and built a camp and makeshift airstrip using a tractor. The ship's crew and expedition team had to survive on the drifting ice for 60 days. They were finally rescued by the polar aircraft.	Vize, 1948
28	1937. August. Icebreaking steamer <i>Sedov</i> . Broke a fan in heavy ice Near Severnaya Zemlya (north) and had to come back to the south.	Nikolaeva, Khromtsova, 1980
29	1937. August. Freighter <i>Sura</i> . The hull was badly damaged by ice at 75° north. Towed by <i>Sadko</i> .	Nikolaeva, Khromtsova, 1980

CONSLUSIONS AND FUTURE INVESTIGATION

It might no be completely accurate to call our collection of accidents a data base, because not all of the accidents in it are presented with equal accuracy and under the same circumstances. There are sets of books, movies and other information available for the most famous shipwrecks such as *Sv. Anna* (1912-1914) and *Cheluskin* (1934). Other vessels are represented by pages of several reminiscence and sets of photos, but have only mentions about the essential parts of accidents.

Reconstruction of the circumstances of these accidents is a task for the future. But even now this set of accident descriptions can be useful for understanding the ice, weather and human conditions in the Arctic and for planning the future activities in this severe region.

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