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Shipping development trends in the Eastern sector of the Northern Sea Route

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ABSTRACT

The Arctic marine transport system of the Northern Sea Route (NSR) has been actively developing over the past few years. This development is uneven; on a permanent basis, year-round shipping is available only in the southwestern part of the Kara Sea, the Ob Bay and the Yenisei Gulf, which is no more than 20% of the total area of the Arctic seas. In this work, using the basic calculation method of the theory of transport systems, an analysis of the differences in the development of the eastern and western sectors of the NSR was carried out. Data on the number of ships, density and intensity of shipping were used as materials and research methods, which were presented as measured parameters of the transport system. Geoinformation modeling technologies were used as an analysis tool. Additionally, the composition of the Arctic fleet, the options for using nuclear and diesel-electric icebreakers and the number of ship calls to ports in the western and eastern sectors were analyzed. It was found that shipping in the Eastern sector of the Northern Sea Route is developing with less intensity. The main trends are a reduction in the number of river-sea class vessels during summer-autumn navigation, and their gradual replacement by vessels with a larger gross tonnage. Transit shipping in the eastern sector is developing only due to the transportation of liquefied natural gas, the rest of the cargo flows remain at the level of previous years. The period of navigation in the Eastern Sector is extended due to earlier navigation in June and is extended in December, but such sea crossings are still sporadic. The port of Pevek received the greatest development due to the construction of port infrastructure and the delivery of the «Akademik Lomonosov» nuclear floating power plant. Possible prospects of year-round use of the Eastern sector and their problems are discussed.

KEY WORDS: Northern Sea Route; Eastern sector; Arctic fleet; Arctic transport system; Geoinformation modeling.

INTRODUCTION

The Northern Sea Route (NSR) is a young Arctic maritime transport system, the development of cargo turnover along which is proceeding at a high rate. However, the development of the NSR is uneven, the main projects with a cargo base are located in the Gulf of Ob Bay and the Yenisei Bay, refer to the southwestern part of the Kara Sea, which is about 20% of the total water area of the NSR. Navigation in the Eastern Sector is carried out only during the summer-autumn navigation period, i.e. in the ice-free period. The reporting materials of a working group of the Arctic Council - PAME (Protection of the Arctic Marine Environment, 2020) provide data on Arctic shipping in Polar Waters (Polar Code), used data from AIS (Automatic

Identification System) for the period 2013-19, which showed an increase in the number of vessels by 25% from 1298 to 1628, for the model period PAME used the month of September, which severely limits the research results for objective analysis. Eguíluz et al. (2016) examines the experience of Arctic shipping for the period from 2010 to 2014, the authors highlight the local months during the year when the intensity of shipping is at its maximum, this is primarily due to ice conditions, but without defining the geographic features of Arctic shipping. Critical situations for navigation in the Eastern Arctic were known during the Soviet period (Barr et al., 1985), early freeze-up in 1983 and strong northwestern wind in September drove perennial ice from the north to the coast of Chukotka, which led to early blocking of ships in the ice. Ostreng et al. (2013) present the results of studies on the conditions that will determine the scale and range of shipping in polar waters in the future, comparing three Arctic transport corridors that are influenced by various factors, from global warming to international economic trends in shipping. In many respects, navigation in the Eastern sector of the NSR is limited due to insufficient hydrographic knowledge (Afonin et al., 2017) of the waterways, especially in straits and coastal routes. The development of port infrastructure (Wang et al., 2019) in the Arctic seas, as a key conductor of cargo turnover, is also uneven. Garibin et al. (2019) presents the difficulties in the construction of berths in the Arctic for handling large vessels with a large draft. The purpose of this research is to study the dynamics of changes in shipping in the eastern sector of the Arctic, since this zone is little considered in scientific publications, and its development limits year-round transit shipping and the connectivity of the northern territories for the Russian Federation.

MATERIALS AND METHODS

In this work, by the eastern sector of the Northern Sea Route we mean the waters of the Laptev sea, the East Siberian and Chukchi seas, i.e. all maritime and port activities located east of the Vilkitsky Strait. To carry out these studies, the official data of the NSR Administration (2021) on applications and permits issued for navigation, daily messages from ships, archived AIS data and port-calls messages from information system were used.

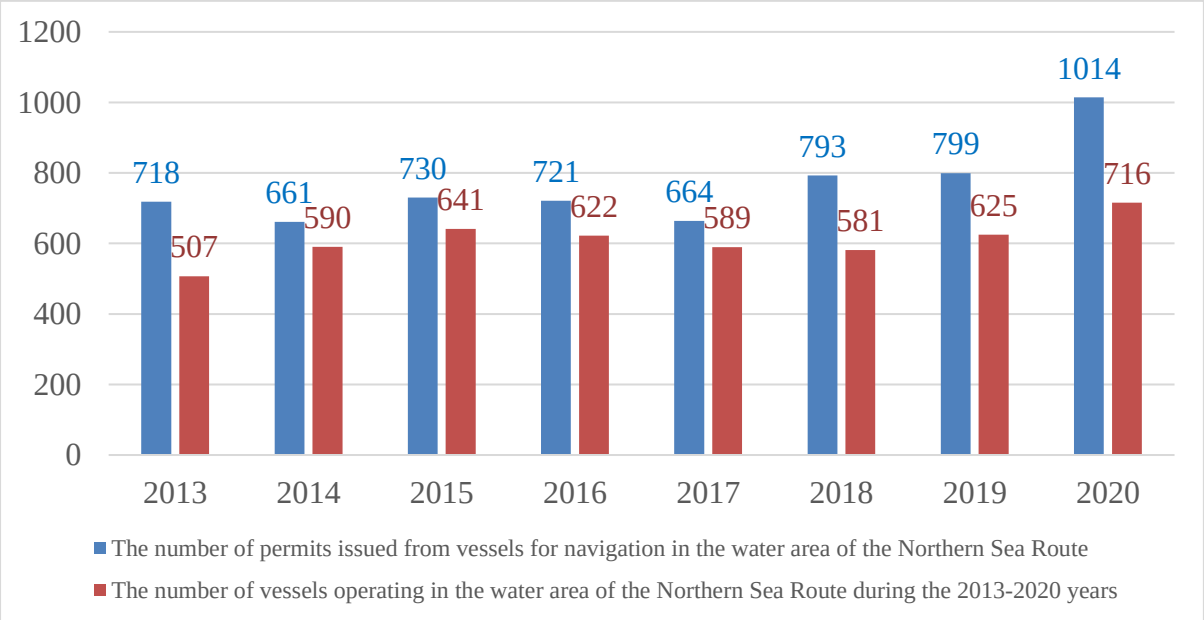

Figure 1. The ratio of the number of permits and vessels navigating in the water area of the Northern Sea Route

Figure 1 shows the number of applications (permits) filed with the NSR Administration for the passage of ships for the period from 2013 to 2020 and the actual number of ships. These data reflect the general situation, individual highs in 2019-20 years correspond to the phase of active construction of the port of Sabetta and the «Utrenniy» terminal of liquefied natural gas (LNG) in Ob Bay. According to official data, the cargo turnover in 2020 reached 30 million tons, which is several times more than in 2013. Such a sharp, multiple increase was due to the use of large-capacity vessels of a high ice class, these are the YamalMax project vessels and the K42 oil shuttle tankers.

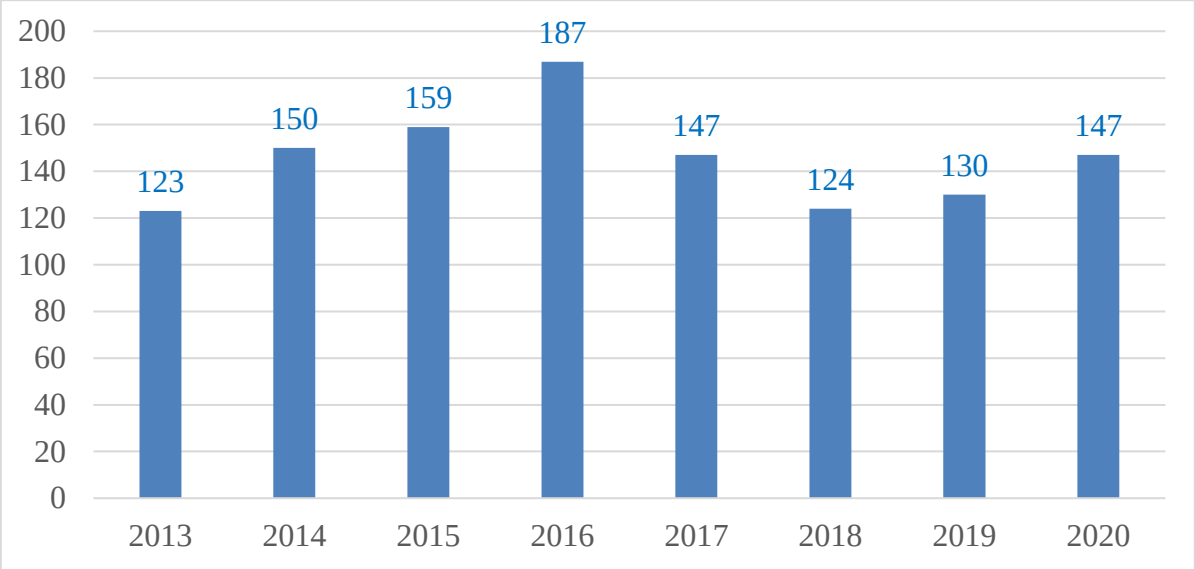

Figure 2. The number of vessels with ice-class Arc4,5 operating in the water area of the Northern Sea Route during the 2013-2020 years

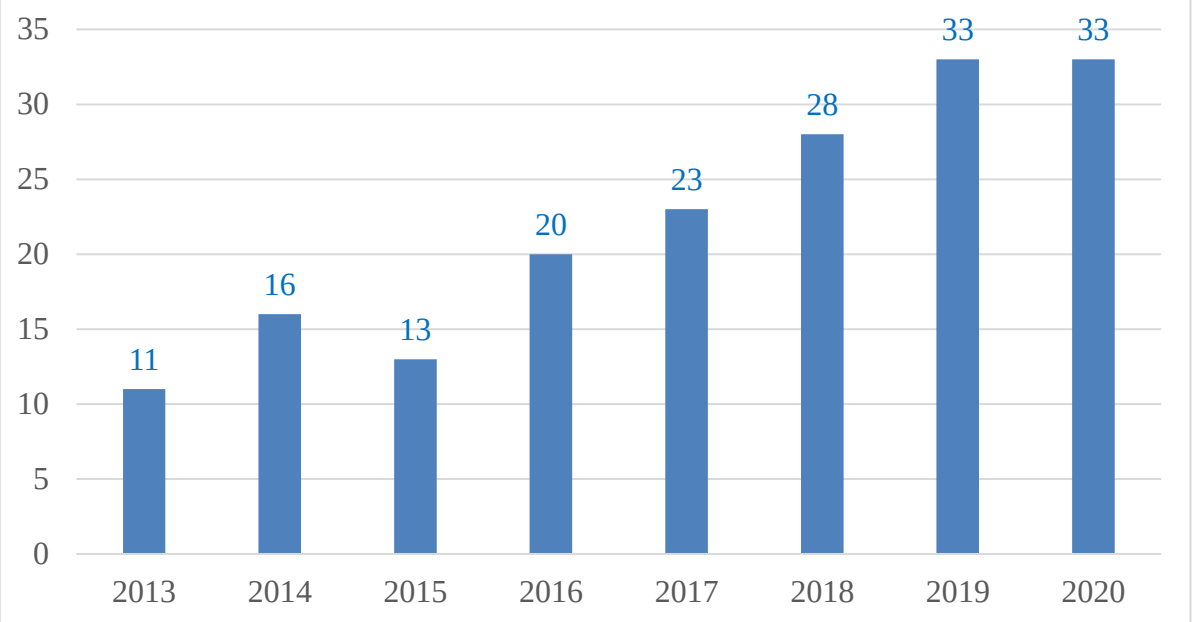

Figure 3. The number of vessels with ice-class Arc7 operating in the water area of the Northern Sea Route during the 2013-2020 years

According to official data, the cargo turnover in 2020 reached 30 million tons, which is several times more than in 2013. Such a sharp, multiple increase was due to the use of large-tonnage vessels of a high ice class, these are the Yamalmax vessels and the K42 oil shuttle tankers. Since 2015, due to the new large-capacity vessels of the high ice class Arc7, their total gross tonnage has increased to 3.5 million tons. Figures 2 and 3 show the dynamics of changes in the number of ships that operated in the water area of the NSR with distribution for 2013-20, the data were retrieved upon requests for navigation to the Administration of the NSR (2021). Figures 2 and 3 show the dynamics of changes in the number of ships that operated in the water area of the Northern Sea Route with distribution for 2013-20, the data were retrieved upon requests for navigation to the Administration of the Northern Sea Route. Figure 2 shows the distribution of ships with ice class Arc4,5, which use icebreaker escort during winter-spring navigation, and figure 3 shows the distribution of ships with ice class Arc7, which sail independently all year round. The total number of ships during the year does not reflect their distribution in the regions of the Arctic seas; to solve this problem, geoinformation modeling technologies (Ol'khovik, 2018) were used.

RESULTS

Despite a significant increase in the number of high-ice class vessels over the past 5 years (Figure 3), the main cargo turnover relates to the Kara Sea, where new projects for the production of hydrocarbons are being implemented. The analysis of shipping that we performed was aimed at comparing the pace of development of the Eastern Sector in relation to the entire NSR. If in the western part we see practically an increase by a factor of two, then in the east the number of vessels operating during the year practically did not change, this is demonstrated by the data in Figure 4, which were obtained as a result of the analysis of vessel traffic using AIS.

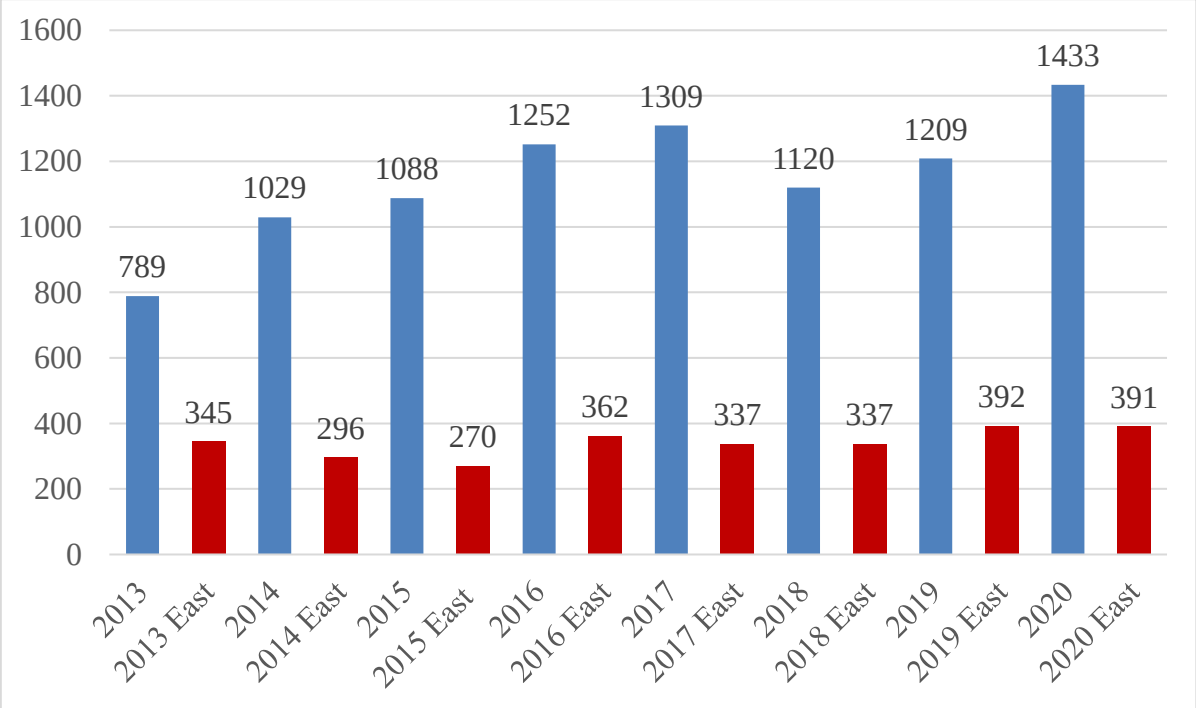

Figure 4. The number of vessels operating on the NSR, all throughout the year and in the Eastern sector of the water area

The second important parameter is the number of ships calls at Arctic sea ports. For the analysis, we used data from the Port State Control Information System (2021), which allows us to single out individual ports calls in the water area of the entire NSR. And here we see a significant difference in trends, in the western part the number of ship calls to ports increased by more than 4 times, while for the eastern sector by about 2.5 times. The results are shown in Figure 5. The main trends are the reduction in the number of river-sea class vessels with low gross tonnage (<2000 tons) during the summer-autumn navigation and their gradual replacement by vessels of larger gross tonnage. Transit traffic in the eastern sector is developing only due to the transportation of liquefied natural gas from west to east, the rest of the freight traffic remains at the level of previous years and is associated with the delivery of consumer goods to the northern regions. The navigation period in the East Sector is gradually extending due to earlier navigation in June and extended in December, but such sea crossings are still sporadic. The port of Pevek received the greatest development due to the construction of port infrastructure and the towing of the Akademik Lomonosov - nuclear floating power plant.

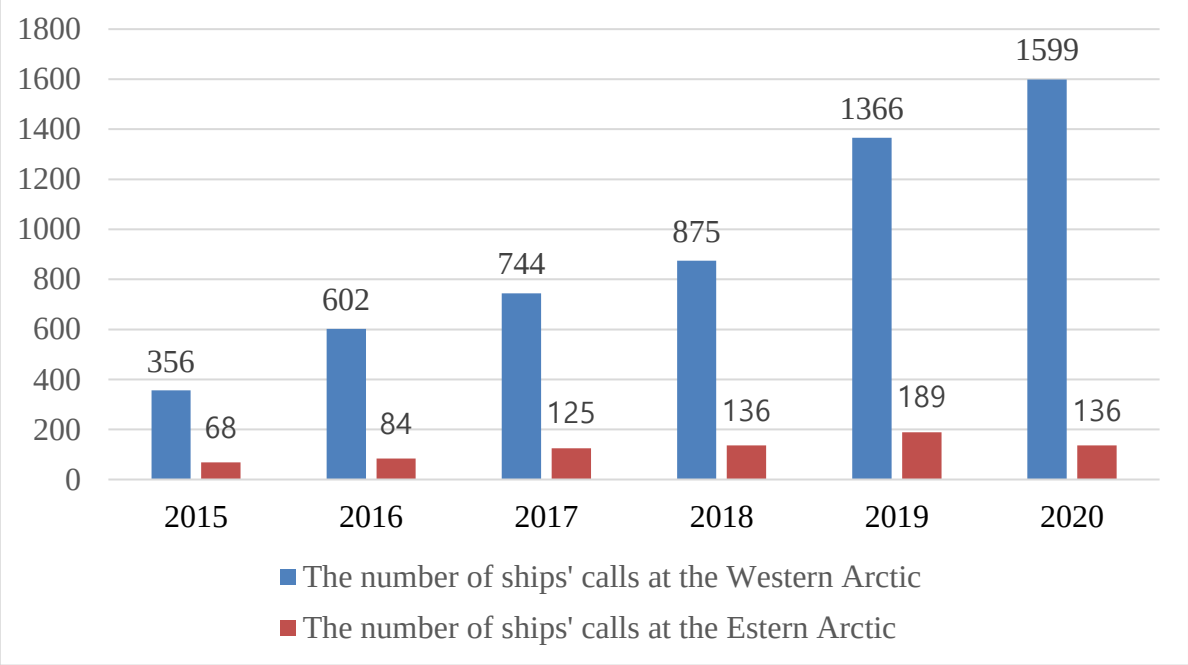

Figure 5. The number of ship calls to Arctic ports for the period 2015-20 years, in the Western and Eastern sectors of the NSR

Additionally, we investigated the number of crossings of ships from the western part of the NSR to the eastern and vice versa, which is shown in Figure 6. The transitions were counted discretely for each month of navigation. This allows data comparisons to be made more objectively, like year-on-year. It found that the number of transit crossings in both directions approximately coincides every year, the deviations do not exceed 10-15%. However, the overall picture is gradually changing, namely, the period of west-east transitions has increased from 4 to 6 months over the past three years, navigation expands. The number of transit crossings in both directions approximately coincides every year, the deviations do not exceed 10%. Moreover, in 2018 it prevailed the transition of vessels to the western sector, in the summer navigation of 2019 there was an earlier transition to the eastern sector and later to the western one, and in the 2020 season the situation changed due to an increase in the number of

LNG carriers' trips to the East due to market conjuncture. The other vessels still don't perform sea crossings between the west and east during of inter navigation periods, preferring only the ice-free period in summer-autumn season.

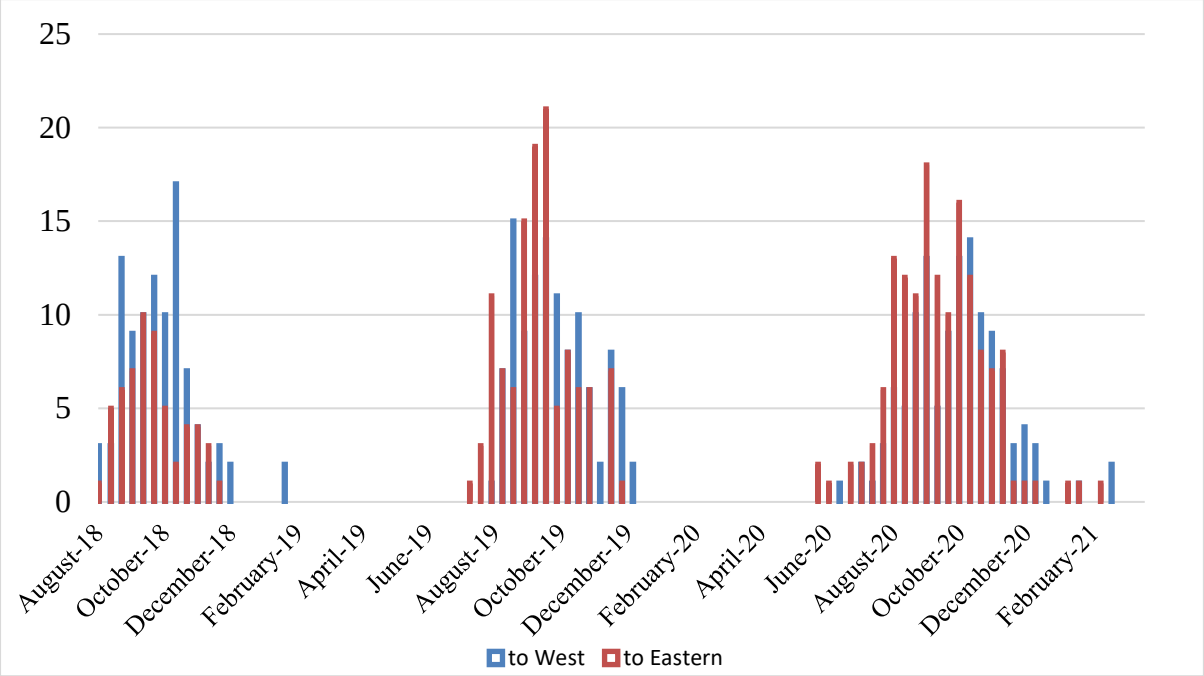

Figure 6. The number of vessel crossings through the Vilkitsky Strait for the period 2018-21 years

Comparing the number of crossings with the data in Figures 4 and 5, it is clear that the transit voyages involve vessels that are not connected to the cargo base of the Eastern Sector, since the number of vessels in the East and port calls has not changed significantly for the last few years.

CONCLUSIONS

According to the results of our research, we found that the Eastern sector of the NSR is developing at a pace that lags behind the Western one. This can be explained by the fact that there are no new development projects, an insufficient cargo base for transportation and the ports of the Eastern Sector cannot accept ships with a large draft and tonnage. Part of the water areas of the Arctic seas is poorly studied by hydrography and navigation in them is difficult. Also, it should be noted that the navigation period in these areas changes quite sharply, our previous research (Tezikov et al., 2020) confirm that the duration of the ice-free period directly affects the cargo turnover. Kholoptsev (2020) in paper shows that ice conditions are not expected to improve in the East Siberian and Chukchi Seas, this trend appears after 2007, but may change in the coming years due to the cyclical effect of ice massifs. Aksenov (2017) also provides data on the possible deterioration of the ice situation in the eastern sector due to the overestimation of the summer ice fraction, which is explained by the recurrence of ice events. New projects may be formed in the Chukchi Sea, their base may be the port of Pevek, which has a short shoulder with the Far East and can accept ships with a draft of 8 meters. The depths in this area are not limited, and the ice conditions are similar to those of the Kara Sea, which is generally sufficient for the development of year-round shipping. In the waters of the Laptev Sea and the East Siberian Sea, the development of seaports does not occur, however, Siberian

rivers are actively used to deliver small cargoes and provide coastal regions, this trend has persisted for many years. Leonov (2021) in article analyzes the prospects for the development of ports in the eastern sector of the NSR, a forecast is made that by 2035 the cargo turnover may increase 12 times compared to 2019, this estimate seems to us realistic, provided the development of industrial or mining zones in the vicinity of the seaports of Yakutia and the north Chukotka. A very important obstacle will be the need to carry out dredging works on the approach channels, which should ensure the approach of vessels with a depth of up to 6 meters. The use of icebreaker escorts in the seas of the eastern sector of the NSR is sporadic and refers to the beginning or end of summer navigation, less often for transit crossings of LNG tankers, although this practice can expand with a decrease in the ice period and is promising in case of replenishment of the icebreaker fleet.

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