SHIPPING-RELATED IMPACTS OF THE OIL AND GAS SECTOR ON MARINE BIODIVERSITY IN THE ARCTIC

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SUMMARY

As climate warming shrinks Arctic sea ice and oil-and-gas production in the region grows, the circumpolar north is experiencing a rise in shipping traffic—especially from oil tankers and liquefied natural gas (LNG) carriers. According to new research by the WWF Global Arctic Programme, the number of crude oil tankers operating in the Arctic almost doubled in the past decade and the distance they sailed increased threefold during the same period. The number of LNG ships operating in the Arctic increased even more, up to 120 in 2024 from just 44 in 2014, and the distance they sailed increased nine times.

The shipping routes of the Arctic fleet linked with the oil and gas sector cut directly through many areas identified as priority for conservation. With them, come growing wildlife perils, including greenhouse gas emissions and pollution, the threat of oil spills, potential ship-animal collisions, underwater noise that interferes with whales and even bird-disrupting impacts from ship-board lighting.

The research shows three Arctic regions to be particularly affected: the Bering Strait, the Kara and eastern Barents Sea region and the adjacent Norwegian and western Barents seas.

The Bering Strait is both a biological hotspot and one of the Arctic's most important marine seaways. Its 85-kilometre width funnels immense seasonal migrations of bowhead, beluga and grey whales, as well as walruses, seals and millions of seabirds. Since 2014, however, the number of crude oil tanker and LNG carrier passages through the strait increased from 14 to 128 in 2024. Meanwhile, LNG carriers were shown to be the fastest vessels among all ships linked with the extractive sector in the Arctic. In 2024, their average speed was15 knots, double that of the general cargo vessels. Sailing at this speed elevates the risk of collisions with marine mammals.

The Kara Sea and eastern Barents Sea region north of Russia is even busier. Oil tankers move through the region's Pechora Sea and Kara Strait year-round—40 to 60 crossings per month. Additionally, to the tanker traffic, a fleet of smaller and older service vessels and tugs is numerous in this region as well as in the vast estuary of **the Ob and Yenisey Rivers.** Located nearby, it has the busiest ship traffic along the Northern Sea Route. The dredging activities performed to enable the navigation of large ships have changed the hydrological regime and the ecosystem of the Gulf of Ob. In addition, maintenance of the open-water channel through the ice during winter and the construction of a new oil terminal adds to the shipping pressures in this area.

The biologically rich **Norwegian and western Barents seas**, meanwhile, expect more tankers after an anticipated 20 percent rise in oil production in 2025.

The WWF study suggests key mitigation steps can help, including ensuring vessels use cleaner fuels, improving oil-spill emergency infrastructure, replacing old ships with new ones and supporting monitoring and more research. These are **standard** measures that should be pursued across the entire Arctic region.

Meanwhile, operational measures **specific** to each Arctic subregion are important for reducing underwater radiated noise and the risks of strikes with marine mammals. These operational measures

include integrating regional and subregional biodiversity data in voyage planning, slow steaming, rerouting whenever possible to avoid contact with migrating mammals, and adopting dynamic measures informed by real time and seasonal biodiversity data available to mariners on the bridge.

Finally, and perhaps most importantly, governments and companies should embrace the call for the gradual phasing out of the fossil fuel projects. This will reduce greenhouse emissions in the coming decades while also lessening the shipping impacts on marine ecosystems that come from the oil-and-gas-related fleet.

Synopsis

This report continues WWF's series on Arctic oil and gas development and examines how shipping linked to these projects affects the region's marine environment and climate.

The increasing interest in untapped natural resources in the Arctic is driving attention from industry and governments to the Arctic's role in transporting these resources, particularly through shipping. Hundreds of tankers and liquefied natural gas (LNG) carriers traverse pristine marine ecosystems and hazardous waters to deliver Arctic oil and gas to overseas markets. This increasing traffic is creating new risks for—and pressures on—marine and coastal life. Although shipping density in the Arctic is generally lower than it is in other parts of the world, its upward trend means we need forward-looking strategies to minimize the impacts of industrial activities on the region, which has long been defined by its largely intact natural environments. In addition, many Indigenous Peoples and coastal communities in the Arctic depend on the well-being of ecosystems and animals for their livelihoods and cultural practices.

This paper analyzes the risks to biodiversity from the impacts of shipping associated with oil production in the Arctic. To address these risks and impacts and safeguard Arctic marine biodiversity, we offer Arctic- and industry-wide suggestions for regulation as well as local and regional solutions.

Main findings

- The number of oil tankers and LNG carriers, and their traffic has increased over the last decade. The number of crude oil tankers operating in the Arctic almost doubled whereas the number of LNG ships has increased even more, almost threefold over the past decade. The greatest increase has been observed in the Bering Strait area.
- The oil and gas sector does not rely solely on vessels that deliver hydrocarbon products, such as oil tankers, liquefied petroleum gas (LPG) carriers and LNG carriers. It also requires a substantial fleet of supporting vessels, including service vessels, tugs, general cargo vessels, dredgers, icebreakers and others. The impacts of these additional fleets must also be considered when assessing the impacts of oil and gas production and transportation.
- Many routes related to oil and gas projects overlap with priority areas for conservation (PACs) that host species and habitats that are particularly vulnerable to shipping impacts. These conservation priorities should be reflected in impact assessments and when planning mitigation measures. Where mitigation options are limited, compensatory conservation actions should be undertaken.
- These shipping routes cross cetaceans' and other marine mammals' key migratory bottlenecks (the narrow passages they use to move between their winter and summer habitats). Yet data on migrations remain limited. Further research is required to address this issue.
- The paper has identified the species and habitats most affected or at highest risk from oil and gas–related shipping. Targeted research on their seasonal distribution, combined with systematic monitoring, is urgently needed.

Abbreviations

AIS	automatic identification system
HFO	heavy fuel oil
IMO	International Maritime Organization
LME	large marine ecosystem
LNG	liquefied natural gas
LPG	liquefied petroleum gas
NSR	Northern Sea Route
PAC	priority area for conservation
PAME	Protection of the Arctic Marine Environment
ROC-M	Relative Overall Concern by Month
USGS	United States Geological Survey
VLSFO	very low-sulphur fuel oil

Contents

1. Introduction

Overview

Previous WWF reports (2023, 2024) have documented the climate impacts of Arctic hydrocarbon projects along their production and consumption chains. This third paper in the series discusses the risks to marine biodiversity that emanate from shipping activities related to these oil and gas projects.

The Arctic has long been regarded as one of the last nature refuges of global significance because it has been largely spared, until now, from the harmful impacts of industrial developments. However, in recent years, the region has experienced growth in the extraction of mineral resources such as oil, natural gas, iron ore and critical minerals—and this upward trend shows no sign of levelling off. Shipping activities, which are the backbone of Arctic resource development, have grown by almost 40 per cent during the last decade (Protection of the Arctic Marine Environment [PAME], 2024), in part due to the loss of sea ice caused by a warming climate. The Arctic region is warming three times faster than the rest of the world. More tankers and bulk carriers now ply these waters, and many more are expected to join these. Growth in the extractive sector, accompanied by increases in the transportation of Arctic natural resources, means more infrastructure will be built, such as drilling platforms, underwater and terrestrial pipelines, navigation channels, ports and other coastal facilities. In addition to expanding opportunities for resource extraction, these will elevate the risk of pollution and environmental degradation in the Arctic.

Against this backdrop, this paper examines the direct and indirect marine environmental impacts of maritime activities associated with Arctic oil and gas production.

The paper is organized into three parts.

First, we provide an overview of the types and magnitude of the environmental risks related to increased industrial maritime activities. Next, we identify and describe the Arctic fleet related to the development and transportation of fossil fuel products extracted from Arctic offshore platforms and in coastal and near-coastal areas. Lastly, we analyze the specific impacts of oil and gas–related shipping on three areas of interest selected for their importance to biodiversity protection: the Bering Strait, the Kara Sea and eastern Barents Sea, and the Norwegian coast in the Barents Sea.

Our analysis is based on a juxtaposition of three geospatial data layers: the map of current, active oil and gas fields located above the Arctic Circle; the vessel traffic that serves these fossil fuel projects and delivers their products to outbound destinations; and the data layer of Arctic marine and coastal biodiversity features that are vulnerable to industrial impacts, including areas identified as priorities for conservation.

Context

The Arctic is characterized by extreme seasonal variability that influences both human economic activities and the behaviours of the animals that live in and migrate to and from the region.

Most of the central Arctic Ocean is ice-covered, dark and frigid throughout the winter months. However, over the last few decades, the extent of Arctic sea ice has been declining due to a warming climate (Copernicus, 2024). This has enabled more shipping in areas previously deemed inaccessible. Yet less multi-year sea ice does not necessarily lead to safer shipping conditions. Nautical charts for the Arctic are incomplete, often containing minimal or insufficient information to support safe navigation.[1] In addition, climate change is causing more variable, less predictable weather conditions, with higher winds and more dynamic ice. These characteristics make navigation more hazardous, increasing the risk of accidents at sea.

In some areas—such as the northern coast of Norway, southern Iceland, the Murmansk region of northern Russia, and the Aleutian Island chain in the Bering Strait region—ice does not form even during the winter months due to ocean currents and other factors (although these areas still experience darkness and extreme weather). Shipping traffic in these areas is denser than in other Arctic marine environments.

Because these and other challenging environmental conditions have historically made the cost of industrial development much higher than in other parts of the world, the Arctic has so far managed to retain its pristine ecosystems. These harbour endemic species, such as bowhead and beluga whales, walrus, polar bears, reindeer/caribou and others. The Arctic is also home to diverse coastal communities and Indigenous Peoples (the Inuit, Sámi, Yupik and Chukchi, to name a few) whose livelihoods are intricately connected to the health and vitality of these environments. In addition, the Arctic is widely regarded as one of Earth's most fragile ecoregions: its remote ecosystems are particularly vulnerable to damage from the impacts of pollution, habitat degradation and climate change, and are slow to recover after exposure. The harsh weather and remoteness of these areas would also create formidable natural challenges to a timely and effective emergency response in the event of an accident or oil spill. Such an event could cause lasting, devastating impacts.

Environmental impacts from shipping are broad and interconnected, with local, regional and global implications. Key impacts include greenhouse gas emissions, air and water pollution, and the spread of invasive species. Increased vessel traffic also threatens marine mammals, which face heightened risks of fatal collisions and greater exposure to underwater radiated noise from ships. Because of the region's ice-formation cycles, navigation has historically been limited to the summer and fall months, but growing pressure from the extractive industries is driving efforts to make shipping in the Arctic a year-round activity.

Ships are major emitters of carbon dioxide (CO_2) and methane (CO_4), both of which drive climate change. These ships also emit air pollutants that harm the environment and human health, such as sulphur oxides (SOx), nitrogen oxides (NOx) and particulate matter. Among these pollutants, black carbon stands out as a powerful short-lived climate forcer—a super pollutant that warms the atmosphere much more intensely than CO_2 does over short timescales, with a disproportionate

[1] According to the National Oceanic and Atmospheric Administration (NOAA), only 5 per cent of the US maritime Arctic is charted to modern navigation standards. See NOAA, 2016.

impact on polar regions. When black carbon settles on ice and snow, it darkens their surfaces, causing them to absorb more sunlight and melt faster. This accelerates the loss of the Arctic's reflective (or albedo) surface, amplifying regional warming.

Vessels operating in Arctic waters use different types of fuels. Roughly half rely on residual fuels—the leftover components of crude oil, including heavy fuel oil (HFO). These fuels are used by large vessels, like oil tankers or bulk carriers. Combustion of residual fuels is responsible for releasing most of the CO_2 emissions and pollutants. A recent study of SOx and NOx emissions in Russia's Northern Sea Route (NSR) demonstrated “a robust linear relationship” between the increases in these emissions and increases in the level of oil and gas production (Figenschau et al., 2024).

The other half of the Arctic fleet, which includes smaller vessels like fishing boats, relies on lighter distillate fuels (Arctic Council, 2024). While these also pose environmental risks, their impacts are smaller than those of residual fuels and HFOs. When spilled in seawater, heavy residual fuels emulsify on the ocean surface, mix with and adhere to ice, and may sink and coat the seabed. In contrast, distillate fuels, such as marine gas oil (MGO)—despite having higher toxicity and greater spreading capacity (Helle et al., 2020)—dissipate and evaporate faster. They also produce far lower levels of sulphur and black carbon emissions (Clean Arctic Alliance 2024).

A newer type of residual fuel known as very low-sulphur fuel oil (VLSFO) is now widely used in Arctic shipping to comply with the International Maritime Organization (IMO) cap on sulphur content. Although VLSFOs contain less sulphur than HFOs, these oils solidify into waxy clumps when spilled in cold waters. (HFOs remain liquid, although very thick.) It is “extremely challenging” to clean up a VLSFO spill in cold water using existing techniques and equipment (PAME, 2025).

Given these differences in how fuels behave during spills, the implications for marine biodiversity also vary. Benthic fauna and seabirds are more vulnerable to the negative impacts of heavy residual fuels, whereas fish are more exposed to the risks associated with spills of lighter fuels. Arctic species that live near areas of dense shipping traffic have a higher risk of being exposed to the negative consequences of oil spills. Walruses (*Odobenus rosmarus*) are an example: molluscs, their preferred prey, accumulate oil-derived toxins, which means walruses are exposed to the chronic and long-term impacts of contamination (Chapman & Riddle, 2005).

Some vessels fuelled by HFOs have special exhaust gas cleaning systems, known as “scrubbers,” to reduce the amount of atmospheric sulphur emissions. Scrubbers capture harmful sulphur oxides as well as heavy metals and acidic compounds. Yet because most scrubbers are open-loop systems, they release these captured pollutants directly into the ocean. This simply turns air pollution into toxic water pollution, creating risks to marine biodiversity and human health.

In addition to their reliance on residual fuels—a major source of air pollution—tankers have more significant negative impacts on marine mammals than do smaller vessels.

Specifically, two direct threats to the lives and well-being of whales should be mentioned: underwater radiated noise and ship strikes.

Marine mammals, including endemic Arctic whales (bowheads, beluga and narwhal), use sound for critical life functions, including communicating, navigating, finding prey, detecting predators, and mating. Even small increases in underwater noise levels can have detrimental effects on these mammals. Cumulative effects can degrade and distort their vital life functions (PAME, 2025). Over the last decade, the increase in underwater radiated noise levels in the Arctic region was estimated at about five decibels—an increase of approximately 215 per cent. This rise is primarily due to two factors: diminishing sea ice and increasing ship traffic (Jalkanen et al., 2022).[2] Tankers and bulk carriers are particularly noisy; their main sources of noise are propeller cavitation and engine machinery. In polar waters, icebreaking by vessels also contributes to higher underwater radiated noise levels.

Increases in underwater noise levels are also driven by other industrial activities, such as offshore oil and gas exploration and production, marine dredging to improve navigational conditions, coastal mining, and port development. In the last decade, considerable dredging work has been carried on in Arctic coastal regions, and much more is planned by nearly all coastal Arctic governments and industry as part of building enabling port infrastructure and deepening shipping channels to serve the marine transportation needs of the expanding Arctic mineral industries. The excavation of the sea floor has negative impacts on marine seabed habitats. The full effects of dredging on marine ecosystems (likely including both physical and chemical changes to the ocean floor) remain largely unknown (Todd et al., 2014).

Another notable impact of oil and gas–related shipping is the introduction of invasive alien species through two primary means: biofouling, whereby organisms attached to a vessel's hull are transported to new locations and released, and ballast water discharges, whereby organisms picked up in one location may be released through discharges in another. Because oil tankers travel great distances from lower-latitude regions into the Arctic, they can carry non-native invasive species to these sensitive marine environments. If unmanaged, these introductions can threaten and disrupt Arctic ecosystems and livelihoods, causing serious economic harm to coastal communities that depend on fisheries, aquaculture and other marine resources (Arctic Council, 2025).

[2] The global average increase is estimated at three decibels per decade, equivalent to a doubling of the noise level. See Jalkanen et al., 2022.

2. Methodology

The geographical scope of this paper coincides with the map of large marine ecosystems (LMEs) employed by the PAME working group of the Arctic Council. The map comprises LMEs that are 200,000 square kilometres or greater and encompass “coastal areas from river basins and estuaries to the outer margins of a continental shelf or the seaward extent of a predominant coastal current.” The boundaries of these LMEs do not coincide with those of the Arctic Circle or of the Arctic Polar Code area used by the IMO. Rather, the Arctic LMEs map includes the area free of ice around Iceland and the Faroe Islands, the waters off the Norwegian coast, and the regions to the south of the Bering Strait including Aleutian islands (Figure 1).

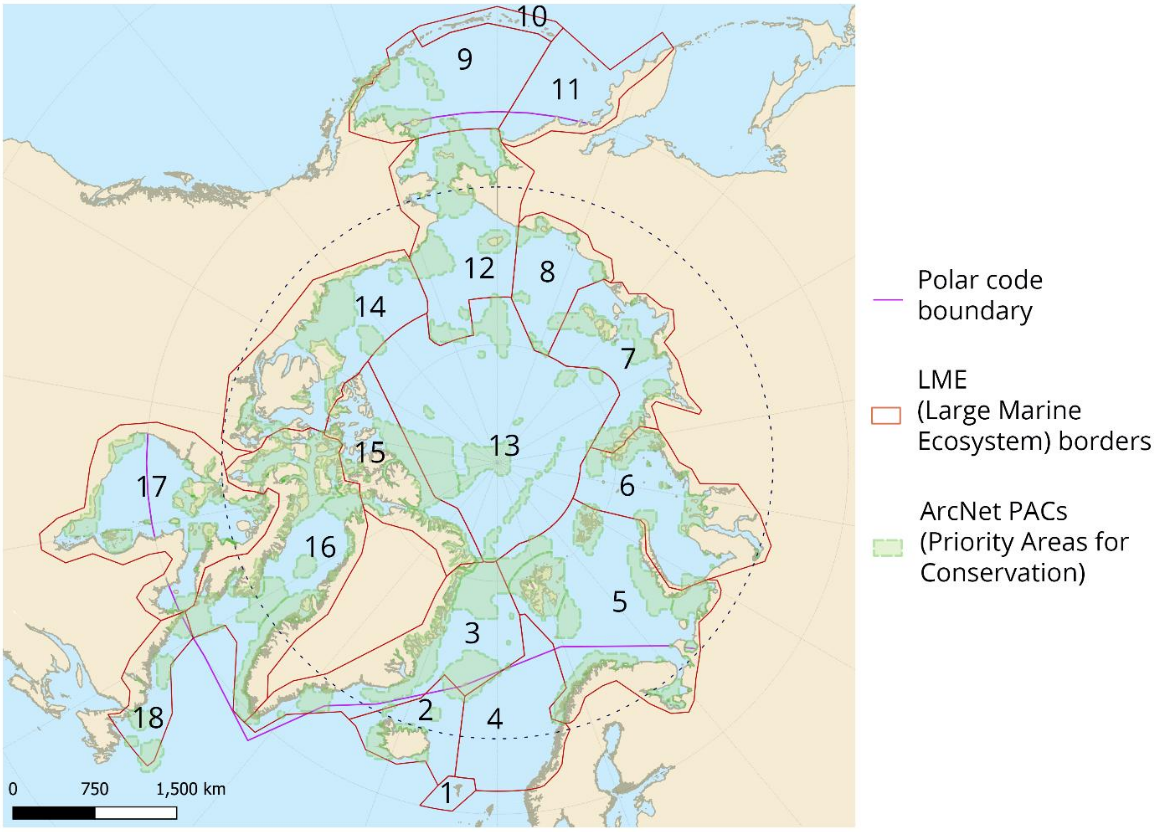

Figure 1: Large marine ecosystems of the Arctic. *Source:* PAME.

1. Faroe Plateau, 2. Iceland Shelf and Sea, 3. Greenland Sea–East Greenland, 4. Norwegian Sea, 5. Barents Sea, 6. Kara Sea, 7. Laptev Sea, 8. East Siberian Sea, 9. Bering Sea, 10. Aleutian Islands, 11. Western Bering Sea, 12. Northern Bering–Chukchi Sea, 13. Central Arctic Ocean, 14. Beaufort Sea, 15. Canadian High Arctic–North Greenland, 16. Canadian Eastern Arctic–West Greenland, 17. Hudson Bay Complex, 18. Labrador–Newfoundland Sea.

These areas are critically important for both Arctic shipping and marine mammals. The Bering Strait is a key migration corridor and choke point between the Pacific and Arctic oceans, linking the summer and winter habitats of hundreds of thousands of seals, walruses and cetaceans, including beluga whales (*Delphinapterus leucas*), grey whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaeangliae*) and bowhead whales (*Balaena mysticetus*).

This paper employs several datasets related to industrial activities in the region and one geospatial risk assessment dataset containing comprehensive data on Arctic biodiversity.

In Section 3, we link Arctic fossil fuel projects with specific vessels. This discussion relies on two key sources of geospatial data:

- The pan-Arctic map of oil and gas production sites is built on the Rystad Energy asset-based database for the year 2024. The dataset includes production and development (soon to be producing) fields located above the Arctic Circle.
- The shipping traffic data included in this analysis combine two separate datasets. The ship movement information is taken from the Global Fishing Watch map for 2024, while the data on individual vessels are obtained from the Clarksons Research World Fleet Register portal. We used the combined dataset to identify a range of vessels involved in Arctic oil and gas projects or the transportation of oil and gas produced in the Arctic. It includes data on the characteristics and movements of oil tankers, LNG carriers, cargo ships, tugs, service ships, dredgers and icebreakers.

In Section 4, we analyze the specific impacts on selected subregions. To select the regions of special interest for Arctic biodiversity, we used two criteria: ecological and biological characteristics, and levels of oil and gas–related shipping traffic. These criteria yielded three areas of interest: the Bering Strait (LME 12), the Kara Sea and eastern Barents Sea (LMEs 5 and 6), and the Norwegian Sea–Barents Sea (LME 5).

The geospatial dataset used for the analysis in this section includes ArcNet PACs (James et al., 2024) and the migration corridors of Arctic marine mammals identified by WWF (Figure 1). The analysis was done with the use of ArcNet Geranium, the Arctic conservation planning tool developed by the WWF Global Arctic Programme. To assess the risks to biodiversity from shipping associated with oil and gas projects, we applied the concept of “conservation concern.” Conservation concern is a WWF framework that involves an expert assessment of the risks to long-term conservation objectives for each species and biological community within a chosen area caused by the selected commercial activity. The assessment is based on the extensive ArcNet database of 705 conservation features—from benthos to marine mammals—that systemically represent the distribution of marine biodiversity across the Arctic.

To measure the level of overall conservation concern in each area of interest, Geranium uses a special metric called the ROC-M (Relative Overall Concern by Month). This measures the level of concern by month for the long-term conservation objectives for all species and their habitats within a priority area. In our analysis, this metric captures the susceptibility of biodiversity features to risks from crude oil and LNG carrier traffic.[3]

[3]The ROC-M is expressed as a percentage, with 100 per cent representing the worst-case scenario in which every biodiversity feature has the highest possible level of concern. For the description of the ROC-M metrics and the conservation concern methodology, see Geranium, a tool developed by WWF tool for conservation decision-making: https://wwfarcticprogramme.shinyapps.io/geranium/#section-assessment.

3. Linking Arctic fossil fuel projects and shipping traffic

Arctic oil and gas production sites

The Arctic region contains significant oil and gas resources,[4] and while not all are economically recoverable, those that are may be extracted for decades before they are exhausted.

For the year 2025, Arctic production levels were estimated at 2,979 million barrels of fossil fuels (including oil and the oil equivalent of natural gas), according to 2025 Rystad data and projections. Russia remained by far the largest producer of hydrocarbons, accounting for more than 90 per cent of fossil fuels in the Arctic region. Russia was followed by the US (Alaska), with 171 million barrels, and Norway's Arctic, with 123 million barrels.[5]

Russia

The majority of currently producing fields in the Arctic (shown in red in Figure 2) are found in the Barents Sea and Kara Sea basins, within the Nenets and Yamalo-Nenets provinces, respectively. Almost all of Russia's Arctic projects are coastal. Only one producing field, Prirazlomnoye, is offshore; it is operated by Gazprom Neft on the continental shelf in the southeastern Barents Sea. Varandey, an offshore oil-loading terminal operated by Lukoil, also lies in the Barents Sea, but it exports crude produced from onshore fields.

The rest of Russia's Arctic production exported by sea originates in the Gulf of Ob, from projects such as Novoportovskoye, Yamal LNG and Arctic LNG 2. In contrast, the Gulf of the Yenisey River is currently dominated by service-vessel traffic linked to the Vostok Oil megaproject now under development. These areas are supported by extensive infrastructure, including pipelines, ports, and oil and LNG terminals.

Russia's Arctic coastline spans half of the entire Arctic Ocean. Several maritime routes connect the country's Arctic ports and terminals, to which hydrocarbons from offshore and onshore fields are delivered via pipelines or shuttle tankers. The key ports servicing oil and gas related fleet in the Barents Sea are Murmansk and Arkhangelsk, whereas in the Kara Sea relevant coastal infrastructure includes Varandey terminal, Vorota Arktiki (or Arctic Gate), Yamal LNG, Arctic LNG 2, and Bukhta Sever (or Sever Bay).

[4] The Arctic region contains about 13 per cent of the world's undiscovered oil (90 billion barrels) and 30 per cent of its undiscovered gas resources (United States Geological Survey, 2008).
[5] Rystad Cube Database, 2025.

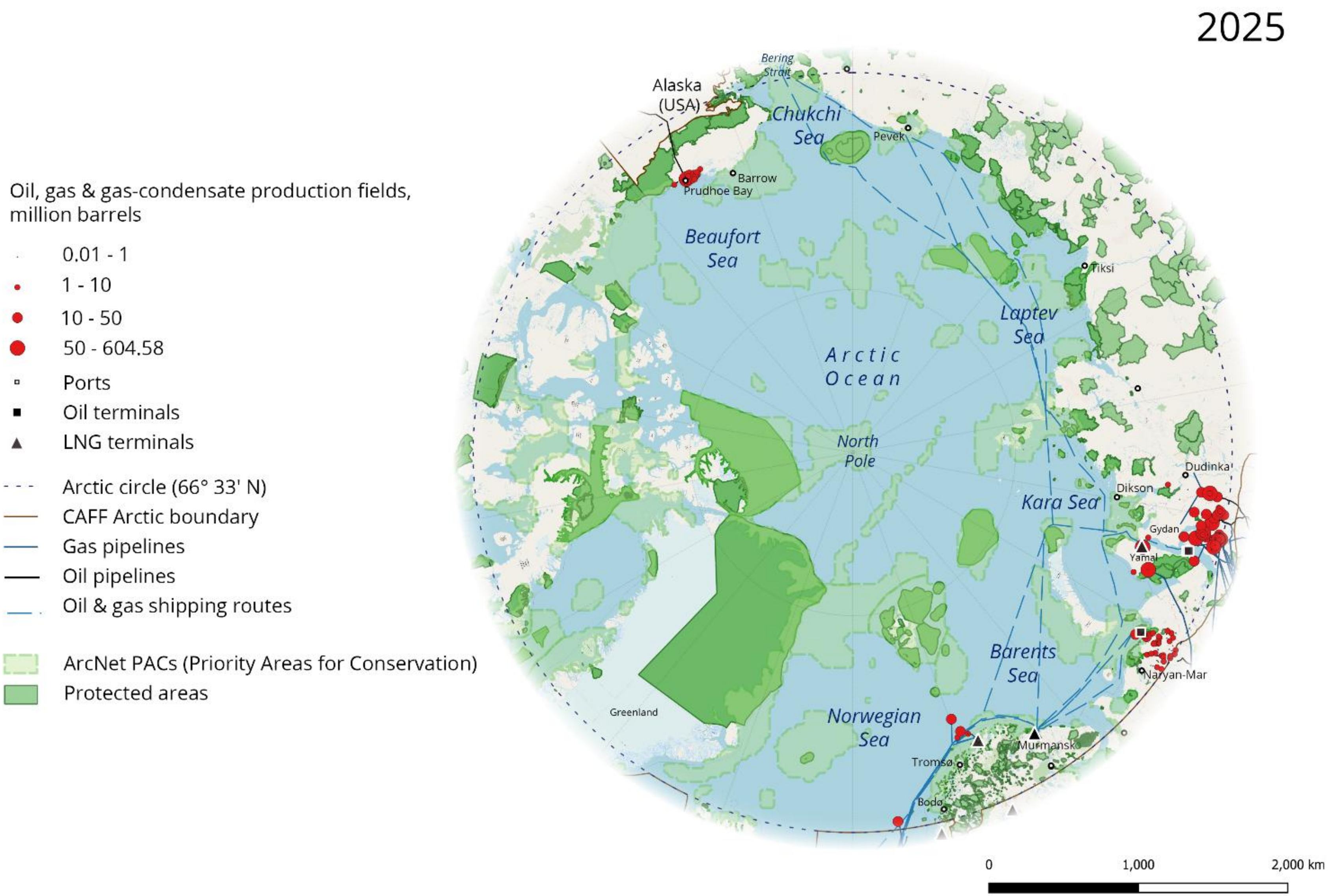

Figure 2: Oil and gas projects in the Arctic and associated shipping routes. *Source:* Rystad 2025.

After oil from Prirazlomnoye, Varandey and Novoportovskoye reaches Murmansk, it is exported by a fleet of tankers via a route along the Scandinavian coast.

Two additional transshipment bases are located on the Kola and Kamchatka peninsulas at the western and eastern sides of Russia's Arctic Ocean coast. LNG is delivered there by ice-class carriers, then reloaded onto conventional tankers that lack ice reinforcement. This approach helps offset the current shortage of ice-class vessels capable of navigating polar waters.

Previously, nearly all of the oil and gas traffic from these sites was westbound through the ice-free waters of the Barents Sea and along the Norwegian coast. Although our data show that westbound traffic has remained stable, the number of tankers and LNG carriers travelling eastward via the NSR and Bering Strait has increased. However, eastbound traffic is still considerably lower than westbound flows.

Norway

All of Norway's projects in the Arctic are offshore, located in the southwestern part of the Barents Sea. The distances of these projects to the coast vary from 85 kilometres (Goliat) to 240 kilometres (Johan Castberg). In 2025, Norway significantly increased (by 20 percent) its production in the Arctic versus 2024. The increase is due to the March 2025 opening of the Johan Castberg field in the Barents Sea—Norway's northernmost oil field. According to Rystad, Norway's fossil fuel production in the Barents Sea will peak from 2035 to 2040, mostly due to Johan Castberg, for which gross recoverable volumes are estimated at 450 to 650 million barrels of oil.[6] These volumes will be transported by crude oil shuttle tankers.

Three other producing fields on the Norwegian continental shelf are Snøhvit (gas and gas condensate), Goliat in the Barents Sea (oil), and Aasta Hansteen (gas) in the Norwegian Sea. These offshore fields employ a variety of vessel types, depending on production stage.

Goliat offloads oil to shuttle tankers for transport. Snøhvit is connected by an underwater pipeline to the Hammerfest LNG plant on the island of Melkøya, where the gas is liquefied and loaded onto LNG tankers bound for export markets; gas condensate from the field is offloaded separately onto tankers. Aasta Hansteen transports gas via pipeline to the Nyhamna terminal, while condensate is offloaded to tankers for shipment to external destinations.

US (Alaska)

In Alaska, oil production takes place in the coastal areas of the North Slope adjacent to the Beaufort Sea. The Trans-Alaska pipeline—completed in 1977 and almost 1,300 kilometres long—transports crude oil from the Prudhoe Bay oil field to the Valdez Marine terminal, where it is loaded onto tankers for export. Because this oil is transported overland, there is almost no marine traffic activity in our data associated with North Slope projects. However, this may change in the near future.

Two new onshore fields are under development: ConocoPhillips' Willow project and Santos' Pikka project. There are also plans to explore the coastal areas of Alaska's North Slope, particularly in West

[6] Ibid.

Harrison Bay, where Shell and Narwhal hold exploration leases.[7] There are still many steps ahead. For now, both projects remain in the early stages, with full-scale development not yet imminent.

The US may become, in the foreseeable future, the biggest offshore producer of oil and gas in the Arctic if the government implements the proposed 11th National Offshore Leasing programme (2026-2031) aimed at dramatically expanding offshore oil and gas leasing in federal waters, including offshore Alaska areas.[8]

Types of vessels linked to Arctic oil and gas projects

Our data show that in 2024, roughly 500 vessels were linked to Arctic oil and gas projects. The vessels serve projects from exploration to development and production, including seismic surveys, field development, construction, ship channel maintenance, port improvement, and the transportation of fossil fuel products to markets. The most common types of vessels associated with fossil fuel production are oil tankers (carrying crude, oil products, LPG or chemicals), followed by tugs, offshore vessels, LNG carriers, multipurpose vessels (cargo ships), icebreakers, dredgers, bulkers and others (Figure 3). Tankers supplying coastal communities with fuel products (or refuelling fishing vessels) are not included in the count.

Crude oil, product and chemical tankers

A total of 149 tankers (carrying crude, oil products or chemicals) associated with Arctic oil and gas projects were identified in our database for 2024. In the last decade, the number of crude oil tankers plying Arctic waters has almost doubled, and the total distances they travel have increased threefold (Figure 4). The average deadweight of crude oil tankers used for oil export — that is, the maximum weight they can safely carry — was about 145,000 tonnes, which corresponds to the size of large ocean-going crude oil tankers (Suezmax tankers). All vessels that transport crude oil and oil products to outbound destinations are double-hulled. This is an IMO requirement for oil tankers with a gross tonnage (internal capacity) of 5,000 or more; it aims to reduce the risk of oil spills. Double-hulled oil tankers with protected fuel tanks are exempt from the IMO's Arctic HFO ban until July 1, 2029.

Our data show that 18 of these tankers have engine systems that operate on intermediate fuel oil with 380 centistokes viscosity (known as IFO 380), and all of these have scrubbers, a special exhaust cleaning system. Additionally, there are two oil product tankers whose main engines are set to operate on IFO 380 with scrubbers installed and two LPG tankers with the same settings and scrubbers. The use of scrubbers allows vessels operating on HFOs to meet the IMO's 0.5 per cent cap on sulphur content. However, because most scrubbers are open-loop systems, they release captured pollutants directly into the ocean, turning air pollution into water pollution. Most of these tankers are travelling westward from Murmansk to destinations along the Norwegian coast, and four are linked with Norwegian offshore projects.

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[7] Narwhal proposes to conduct geophysical surveys and exploratory drilling operations, including the construction and operation of ice trials, roads and pads, in West Harrison Bay, Alaska. See *Alaska Beacon,* September 25, 2025.

[8] On November 11, 2025, the US Department of the Interior announced the 11th National Outer Continental Shelf Program for offshore oil and gas lease sales. 21 of these sales are planned for offshore Alaska waters including Beaufort Sea, Chukchi Sea, High Arctic, and the areas in the Bering Strait/Bering Sea. See Bureau of the Ocean Energy Management (BOEM), 2025.

Vessel type	Count	Brief description of activities
Crude, oil product and chemical tankers, shuttle tankers	149	The majority of these tankers (110) were used to export oil and oil products from Murmansk. Others were shuttling oil from Novoportovskoye, Varandey and Prirazlomnoye to Murmansk or gas condensate from Yamal LNG directly to Europe. Some were exporting from the Norwegian offshore platforms (Goliat, Snøhvit) and the Hammerfest LNG terminal.
Tugs	121	Most tugs have a gross tonnage (internal capacity) of less than 2,000; these service existing project sites and associated infrastructure and deliver cargo and equipment for new projects.
Offshore	65	Offshore vessels deliver supplies, conduct surveys, and provide search and rescue (and other services) for existing projects.
LNG carriers	53	These ships carry liquefied gas from Norwegian and Russian terminals—Hammerfest LNG, Yamal LNG and Arctic LNG 2—to overseas markets.
Multipurpose vessels	33	These vessels mainly deliver cargo for projects under construction.
Barges and inland vessels	21	These vessels deliver cargo for the projects and associated infrastructure in the Ob–Yenisey estuarine region
Icebreakers	18	Icebreakers support shipping routes for tankers and cargo vessels on the NSR and in the Pechora Sea.
General cargo vessels	14	These vessels deliver cargo for projects under construction.
Dredgers	11	Dredgers maintain shipping channels for navigation, particularly near ports and project sites in the Gulf of Ob, including Novoportovskoye, Yamal LNG, Arctic LNG 2 and Vostok Oil.
LPG tankers	8	These carry LPG from the Hammerfest LNG terminal.
Bulkers	4	Bulkers are used for open-hatch deliveries to Vostok Oil.
Heavy lift vessel	1	These are used to deliver equipment.

Figure 3: Types and quantities of vessels serving the Arctic oil and gas sector in 2024. *Sources:* Global Fishing Watch and Clarksons Research.

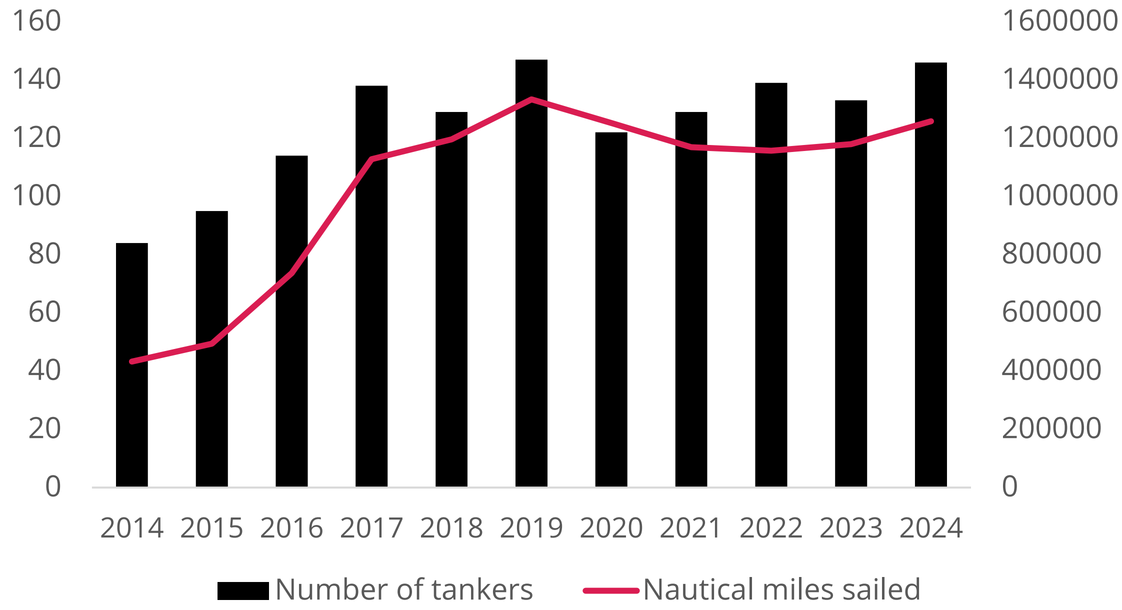

Figure 4: Number of crude oil tankers and the distances they travelled for all Arctic LMEs. *Source:* The Protection of the Marine Environment's Working Group of the Arctic Council, Arctic Shipping Traffic Data (PAME ASTD) (2025).

Other tankers were shuttling oil from the Novoportovskoye, Varandey and Prirazlomnoye oil fields in the Barents Sea to Murmansk or gas condensate from Yamal LNG directly to Europe. Some were transporting oil from the Goliat and Johan Castberg platforms and LNG from the Hammerfest terminal in Norway.

In 2025, the average age of tankers lined with Arctic oil and gas projects was 15.6 years, with some notable variation depending on the project:

- Norwegian offshore oil fields: seven years
- Novoportovskoye: 10 years
- Prirazlomnaya platform: 15 years
- Varandey terminal and export from Murmansk: 17 years

The average speed of these tankers in 2024 was 11 knots. Speeds can vary according to weather and navigation conditions, but do not seem to deviate much from this average.

Tankers operating in the ice-free waters of the Norwegian and western Barents seas generally do not possess an ice class. In contrast, oil tankers engaged in regular operations in the Pechora Sea (the southeastern part of the Barents Sea) and along the NSR are typically built to high ice-class standards (known as IA or IA Super). During August and September, these vessels are joined by at least six additional tankers of lower ice classes (known as IB and IC). At least two tankers having no ice class transited the NSR in September 2024.

Gas carriers

The number of LNG carriers sailing in Arctic waters has increased dramatically over the past decade, from 44 in 2014 to more than 120 in 2024 whereas the distance that they sailed increased nine times

(Figure 5). There were at least 53 LNG carriers linked to Arctic oil and gas projects and delivering liquefied gas from Arctic Norwegian and Russian fields to outbound markets: from Hammerfest (14 vessels), Yamal LNG (27 vessels), and Arctic LNG 2 (at least 10 vessels). Vessels were also carrying LNG from a floating storage facility called Saam, located in Ura Bay on the Kola Peninsula.

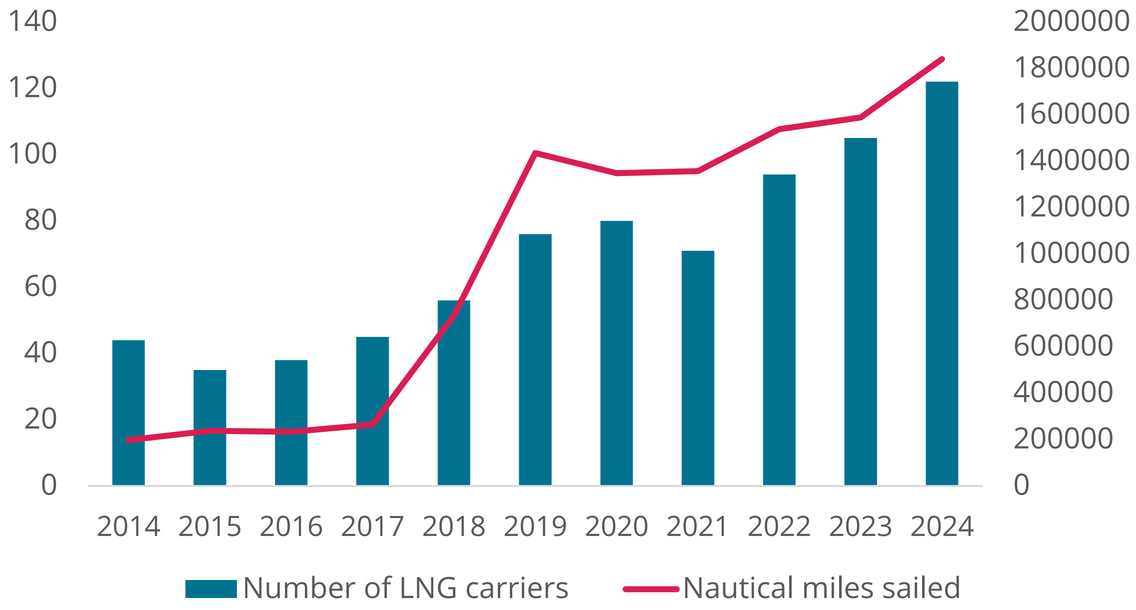

Figure 5: Number of LNG carriers and the distances they travelled for all Arctic LMEs. *Source:* PAME ASTD (2025).

The average deadweight of LNG carriers is 88,845 tonnes. This is lighter than crude oil tankers—yet their average gross tonnage (capacity) is 114,500, almost twice that of oil tankers. This reflects LNG carriers' larger hull volumes and specialized containment systems, which increase vessel size and energy demand per tonne of cargo carried, with implications for port capacity and emissions intensity.

LNG carriers are also the fastest vessels among all ships linked with the extractive sector in the Arctic. The average speed of LNG carriers in 2024 was 15 knots, which is double that of the general cargo vessels sailing in these waters. These are also the newest vessels. In 2025, their average age was nine years.

Because they operate year-round in the NSR, LNG carriers are typically built to high or very high ice-class standards (i.e., IA or IA Super). During the ice-free months (August to early October), these carriers are joined by vessels without any ice class. In total, at least 12 LNG carriers without ice class were identified as operating in the NSR area in 2024.

Service vessels

Icebreakers

All icebreakers supporting the seaborne transportation of oil and gas products operate along the NSR, where their presence is essential for year-round navigation. Russia currently operates 42 icebreaking vessels, of which 18—including eight nuclear-powered vessels—were involved in Arctic oil and gas project supporting activities. In addition to supporting energy transport, these vessels also escort convoys and maintain navigability along the NSR. They are not used exclusively by the oil and gas industry, but serve a broader role in ensuring safe passage through ice-covered waters.

Dredging vessels

Dredgers that are linked with the Arctic oil and gas sector (11) are employed to develop port infrastructure and maintain navigational channels in the Kara Sea's Gulf of Ob. Because of the concentration of newly constructed ports and projects in the area, the Gulf of Ob sees significant tanker and LNG carrier traffic. The operation of these large vessels requires the deepening of shipping lanes in the gulf. The dredging fleet is needed for this ongoing work.

Other vessels

After tankers, tugs are the most commonly used ships linked with Arctic oil and gas projects. Their main functions are to manoeuvre other vessels by pushing or pulling them, to tow offshore drilling units or production vessels, and to deliver cargo and equipment to new projects. Their average age is 33 years, and their average speed is eight knots. Because of their smaller size compared to other vessels (under 2,000 gross tonnage), these vessels often operate in ports, rivers, and travel along shorelines.

Offshore vessels, of which there are also many (65), are mostly owned by oil and gas companies. These vessels deliver supplies, services and surveys, and provide search and rescue for existing projects. Their average age is 14 to 15 years, and their average speed in open waters is nine knots.

4. Subregional impacts: Areas of interest

In this section, we consider the more specific impacts of vessels linked with the oil and gas sector on the three areas of interest selected for their biodiversity characteristics: the Bering Strait, the Kara Sea and eastern Barents Sea, and the Norwegian coast in the Barents Sea. These areas are exposed to more shipping traffic than others. Two of them—the Bering Strait and the Kara Sea and eastern Barents Sea—contain bottlenecks: narrow passages that funnel marine mammals during migration and are also used by vessels carrying oil and gas products.

The Bering Strait

The Bering Strait is one of the most important areas in the entire Arctic region for both marine life and shipping traffic. It has high biological productivity and a complex and dynamic ice regime characterized by dense ice fields, polynyas, leads and fast ice. This complexity creates favourable ecological conditions for the overwintering of several marine mammal species. The strait serves as a critical whelping habitat for walruses, bearded seals *(Erignathus barbatus)* and ringed seals (*Phoca hispida*) (Spiridonov et al., 2020). Several seabird species also overwinter here, including spectacled eiders (*Somateria fischeri*), common eiders (*Somateria mollissima*), king eiders (*Somateria spectabilis*), and long-tailed ducks (*Clangula hyemalis*). The birds also use the strait area during their seasonal migrations. Coastal areas host rich kelp forests, major seabird colonies, salt marshes and breeding grounds for the critically endangered spoon-billed sandpiper (*Calidris pygmaea*).

The narrow and shallow Bering Strait (85 kilometres wide and 30 to 50 metres deep) acts as an important bottleneck for a number of marine mammal species that migrate through the strait to the Chukchi Sea in spring and return to the Bering Sea in autumn. Among these are bowhead whales (*Balaena mysticetus*), beluga whales (*Delphinapterus leucas*), grey whales (*Eschrichtius robustus*) and others.

Because the strait is the only marine link between the Arctic and Pacific oceans, it is also an important shipping route. The marine traffic largely follows the voluntary traffic separation scheme adopted by the IMO in 2018, with one corridor located in the western (Russian) part of the Bering Strait area and another on the eastern (American) side (Figure 6). Additionally, local traffic travels along the coasts of the Alaska and Chukchi peninsula.

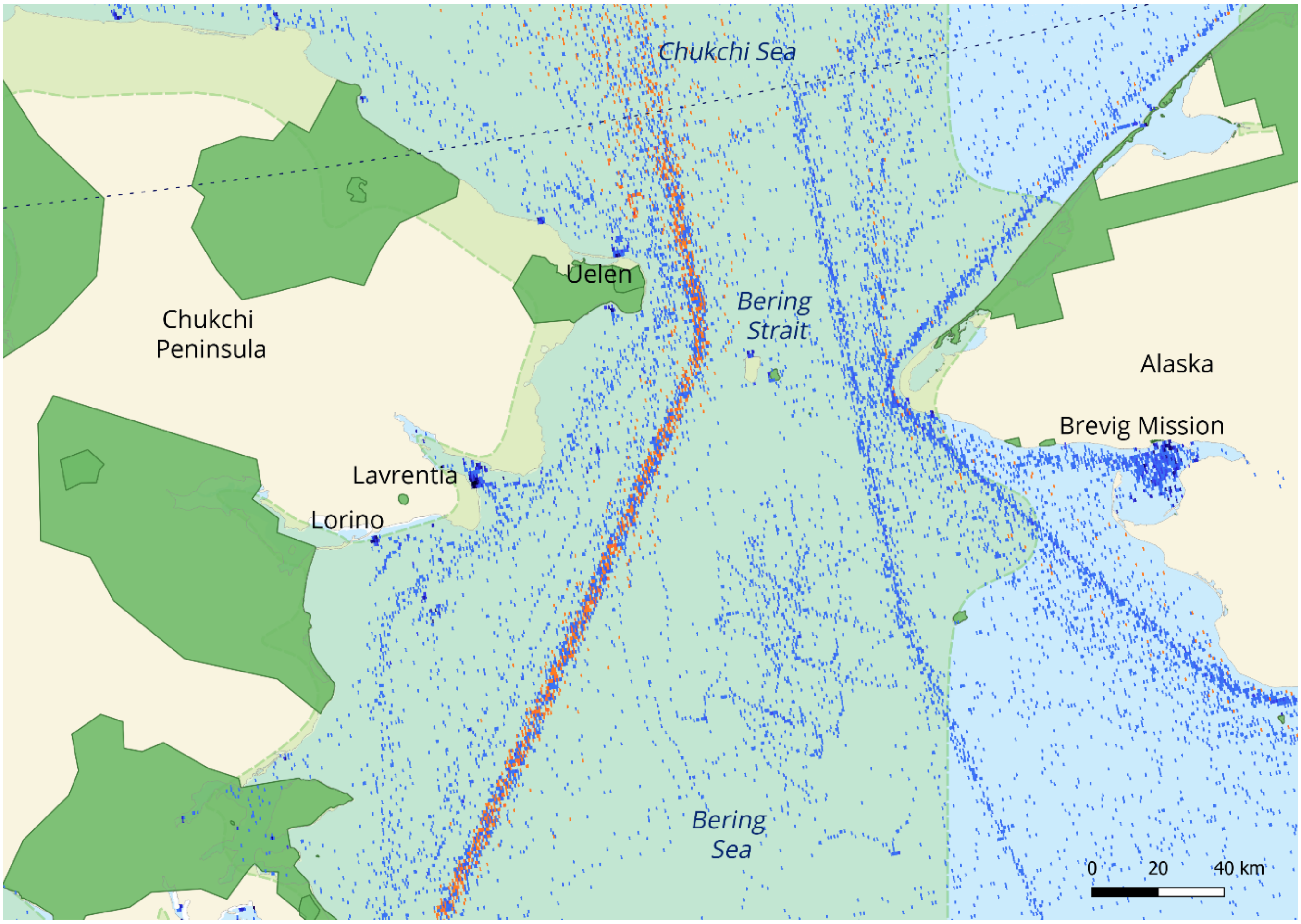

Figure 6: Shipping traffic in the Bering Strait area in 2024. Note: Red dots indicate AIS signals from vessels linked with the oil and gas sector; blue dots indicate AIS signals from all other vessel types except fishing ships; dark blue polygons indicate coastal protected areas; light blue polygons indicate ArcNet priority areas for conservation. *Source*: Global Fishing Watch (2022).

In Figure 6, the red in the trajectory line that runs along the Russian coast shows automatic identification system (AIS) signals from vessels linked with the oil and gas sector (mostly LNG carriers and oil tankers), while blue indicates the AIS signals from all other vessels except fishing ships (which are not included in our data). In 2024, the vessel traffic on the western side of the Russian coast was three times higher than on the eastern side of Alaska.

While shipping traffic in the strait area is not as intensive as it is in the Arctic waters of the North Atlantic, it has been growing—between 2018 and 2024, the number of crossings doubled, rising to more than 600 from 300 (PAME ASTD, 2025). More vessels are expected to traverse the strait in the near future. This is especially true for the traffic associated with Arctic oil and gas projects. The current trend of tankers using the NSR and Bering Strait indicates a significant increase in their numbers starting in 2022 (from 2 to 45 crossings). The number of crossings by LNG carriers has also grown—to 83 crossings in 2024 from 12 crossings in 2018 (Figure 7).

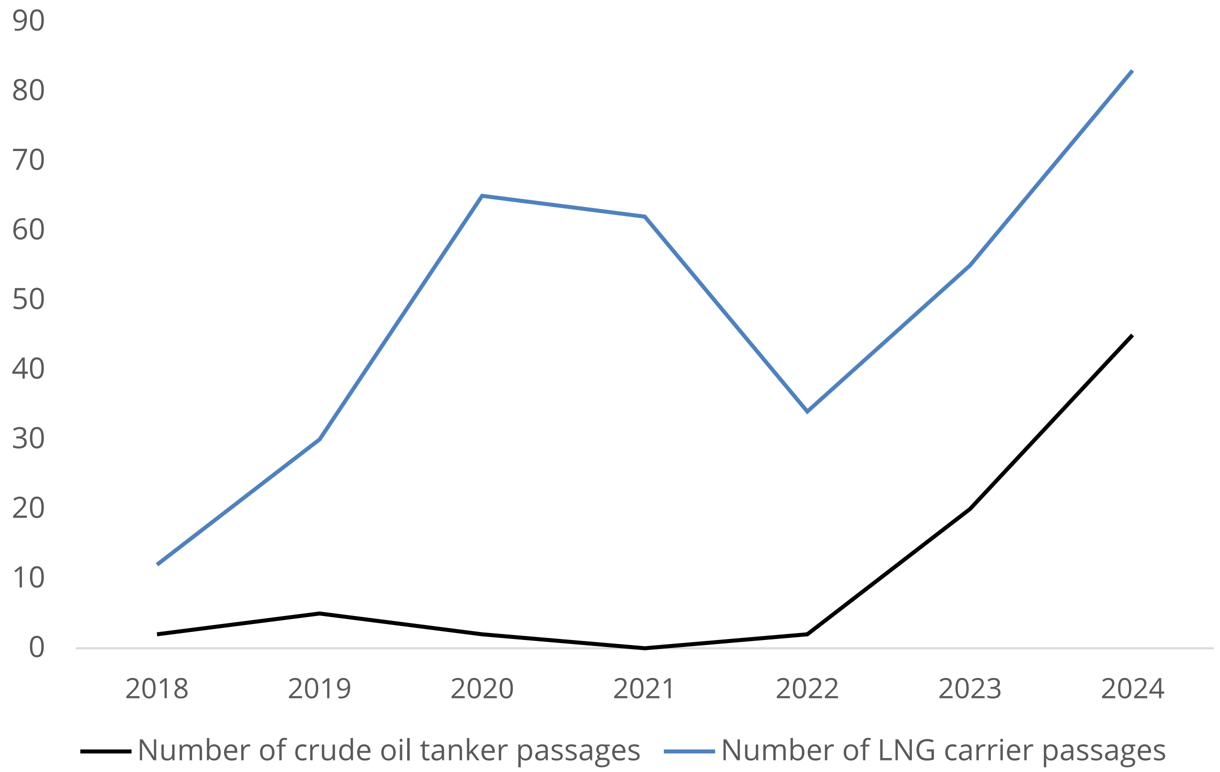

Figure 7: Number of LNG carrier and crude oil tanker passages through the Bering Strait, 2018–2024. *Source:* PAME ASTD (2025).

As shown in Figure 8, oil tankers sail through the Bering Strait area almost exclusively during the ice-free seasons, from June to December, with most crossings taking place from August to October. Most carry oil from the Novoportovskoye project (five tankers in 2024) or Murmansk (11 tankers in 2024). All but one of the tankers travelling through the Bering Strait in 2024 used low-sulphur fuel oil; this indicates that most were not fitted with scrubbers. Of the tankers carrying oil from Murmansk along the NSR and through the Bering Strait, the average year of construction was 2009, with the oldest tankers built in 2003 and the newest in 2019. Only two did not have an ice class.

Because the strait is important for both shipping and marine life, spatial overlap in this narrowly confined space is inevitable. Seasonal patterns of marine use show that the conservation concern level—an indicator reflecting the susceptibility of biodiversity to risks from crude oil traffic—is high throughout the year, with only slight decreases in May and October (see ArcNet/Geranium metrics). This indicates that the peak periods of crude oil traffic coincide with times when the marine species that are most vulnerable to such impacts are present in the strait. This is a source of serious concern, especially over the long term.

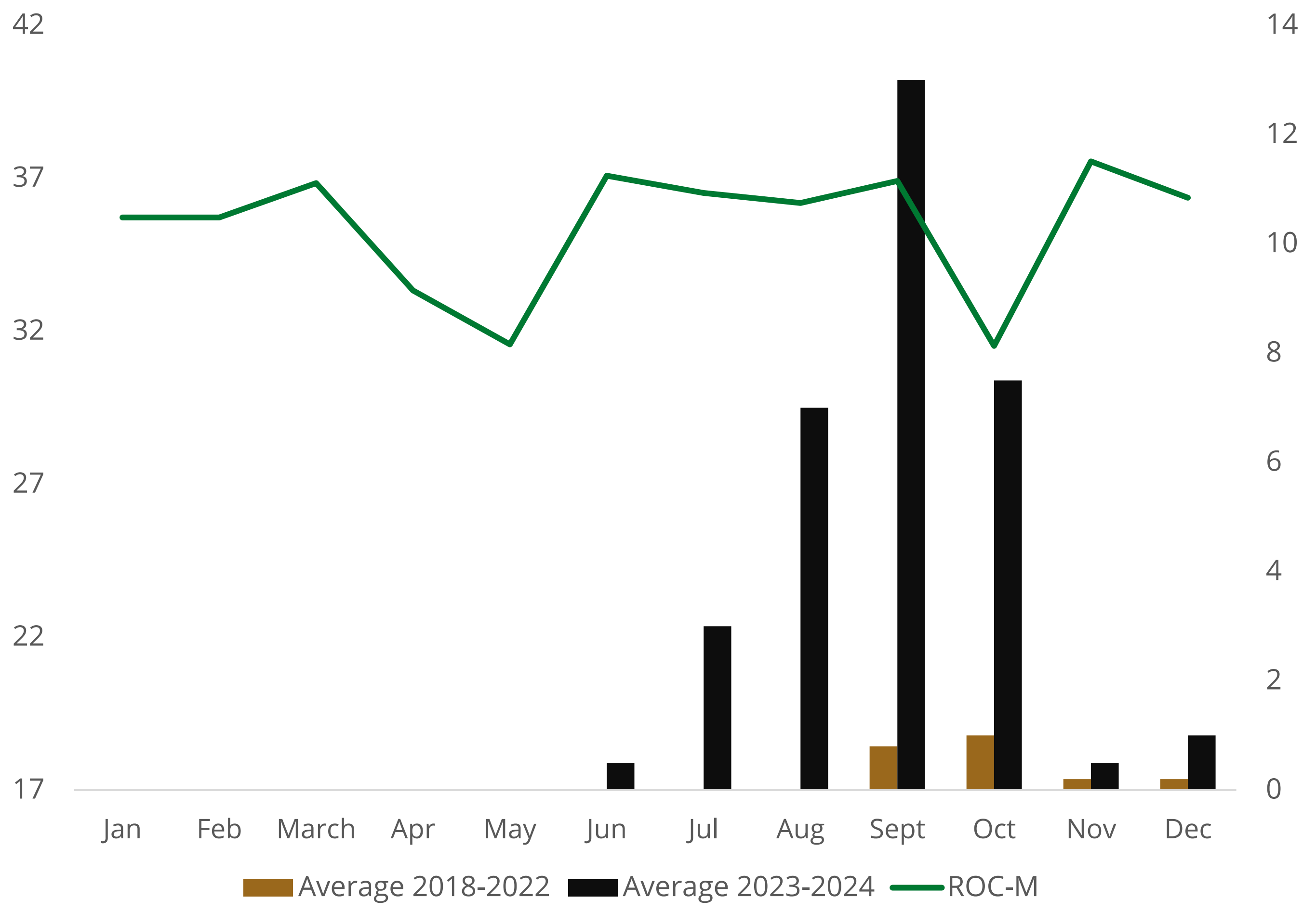

Figure 8: Seasonal dynamics of crude oil tanker crossings and monthly conservation concern levels in the Bering Strait area. *Sources:* PAME ASTD (2025), ArcNet.

Some ecological features are more vulnerable to oil tanker traffic than others. These include benthic communities, kelp forests, cold-water coral communities, and salt marshes, as well as key habitats used by marine mammals and seabirds. Among the latter are walrus haulouts and feeding grounds, humpback whale (*Megaptera novaeangliae*) and grey whale summer feeding areas, and critical moulting, breeding and migration stopover sites for king eiders, Steller's eiders, long-tailed ducks, and common eiders (Figure 9). The main risks and impacts from oil tanker traffic are associated with oil spills, ship strikes, air and water pollution, and underwater radiated noise.

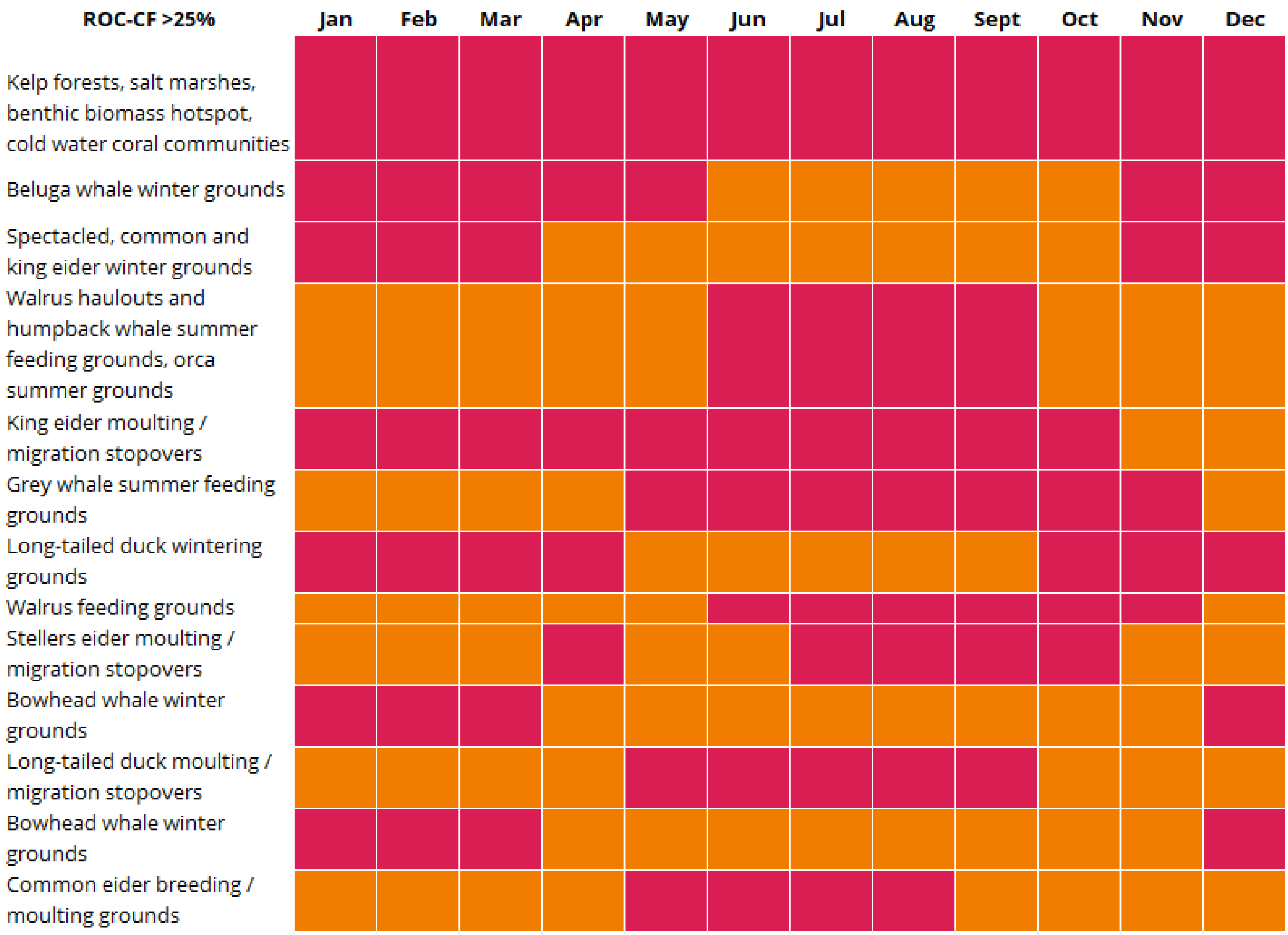

Figure 9: Key biodiversity features in the Bering Strait with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Sources:* ArcNet/Geranium.

As for the LNG carriers transporting gas from the Yamal LNG or Arctic LNG 2 projects, these also use the strait mostly during the ice-free season or when the ice cover is less thick and dense. The conservation concern level associated with LNG carrier traffic is lower than for oil tankers, peaking in July and August, with the main threatening factors being vessel strikes and underwater radiated noise (Figure 10).

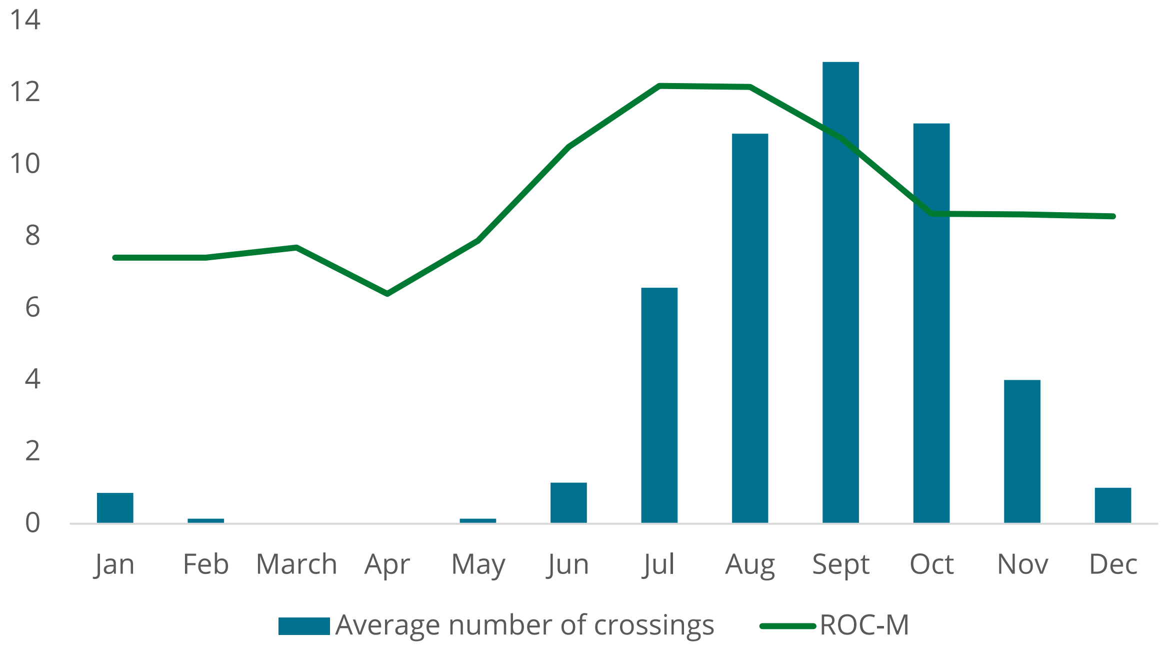

Figure 10: Seasonal dynamics of LNG carrier crossings and monthly conservation concern levels in the Bering Strait area, 2018–2024. *Sources:* PAME ASTD, ArcNet.

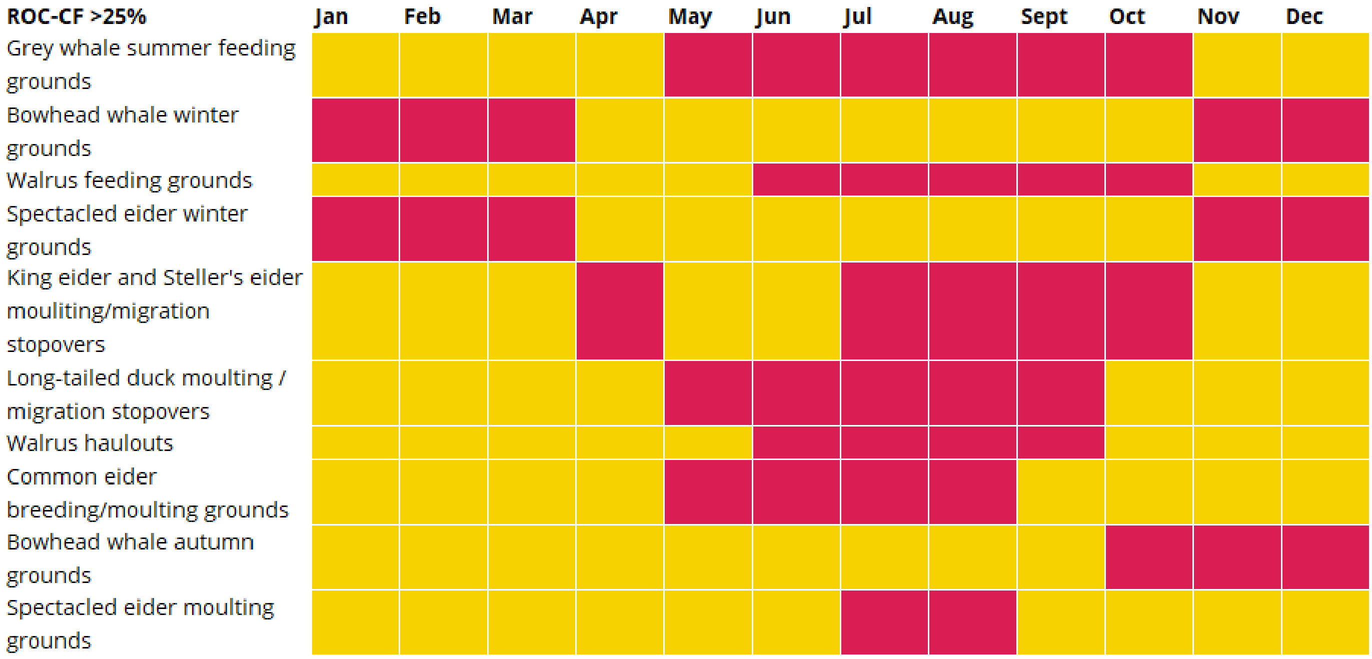

Figure 11. Key biodiversity features in the Bering Strait with highest level of conservation concern stemming from LNG carrier traffic by month. Red indicates a significant level of conservation concern, with risks from transiting through the habitat area during the specified months considered non-mitigable. Yellow indicates a minor level of conservation concern, with risks from passing through the habitat area during the specified months considered mitigable by adhering to existing environmental standards and best practices. *Source*: ArcNet.

According to our data, LNG carriers were among the fastest ships operating in Arctic waters in 2024. Their average operational speed was almost 15 knots. From June to September, out of 90 passages through the strait involving speeds higher than 12 knots, 37 were made by LNG carriers. These crossings happen during the same season when the strait is crossed by marine mammal species that are vulnerable to ship strikes and underwater noise pollution (Figures 10 and 11).

An additional impact of increasing traffic in the Bering Strait is light pollution, which disorients migrating birds flying at low altitudes and can lead to collisions. This is particularly relevant in autumn, when daylight decreases in the region.

Oil and gas–related traffic in the Bering Strait is projected to grow as the Vostok Oil project increases production.[9]

The Kara Sea and eastern Barents Sea

The Kara Sea and eastern Barents Sea is another region where oil and gas–related shipping overlaps with ecologically significant marine habitats.

Three areas of high conservation priority identified by ArcNet are particularly affected by shipping linked to oil and gas development. These include (light green areas, Figure 12):

- the Pechora Sea and Kara Strait in the southeastern Barents Sea
- Cape Zhelaniya north of the Novaya Zemlya archipelago at the boundary between the Barents and Kara seas
- the Ob–Yenisey estuarine region in the Kara Sea

The Pechora Sea and Kara Strait

The Kara Strait, located between the Barents and Kara seas, is the main gateway for shipping along the NSR. Navigation conditions along the route, especially in its eastern sector, are treacherous throughout the year, influenced by shifting ice, dangerous ice masses and shallow areas. Migrating ice can choke critical passages even during the summer. In winter, when the NSR freezes completely, navigation is possible only with the help of icebreakers.

To the west, the Pechora Sea refers to an area in the southeastern Barents Sea. A shallow area with high benthic biomass, it provides important year-round habitat for walruses as well as for benthic-feeding seabirds, including three eider species and long-tailed ducks that gather here from mid-summer to early autumn. The region also supports abundant fish populations, including polar cod (*Boreogadus saida*), Pacific herring (*Clupea pallasii*), and other species. The Kara Strait is an important migration bottleneck for beluga whales (*Delphinapterus leucas*) who spend winter in the eastern Barents Sea and migrate to the Kara and Laptev seas for the summer.

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[9] The annual capacity of the terminal that is under construction at Bukhta Sever (the Vostok Oil project) is 25 million tonnes. Oil shipments are expected to begin in 2026. See Vakulenko, 2025.

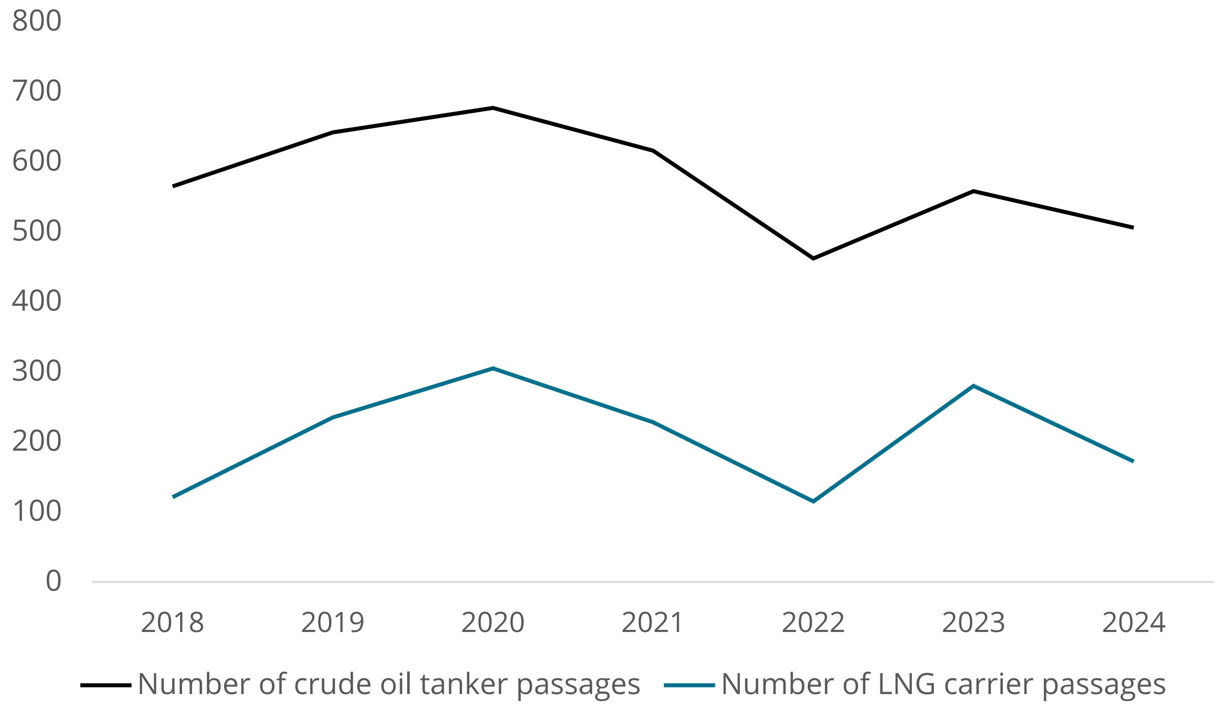

Figure 12: Number of LNG carriers and crude oil tanker passages through the Pechora Sea, 2018–2024. *Source:* PAME ASTD (2025).

This area experiences high-intensity shipping traffic associated with the transport of hydrocarbons from Russia's main Arctic projects (Figures 12 and 13). Russia's only offshore Arctic oil platform, Prirazlomnaya, contributes to vessel traffic in this area, with shuttle tankers transporting oil year-round from the platform to Murmansk. Similar operations take place at the nearby Varandey terminal, an offshore oil export facility located about 20 kilometres from shore. Other terminals at which hydrocarbons are loaded onto tankers are located further east across the Kara Sea in the Gulf of Ob and Yenisey Bay. These include the Yamal LNG, Arctic LNG 2 and Vorota Arktiki terminals as well as Bukhta Sever, which is currently under construction.

In 2024, the vessel traffic from these terminals was mostly westbound, towards Murmansk, where hydrocarbons are reloaded onto larger tankers and transported further west along the Norwegian coast. The westbound traffic also includes LNG carriers delivering liquefied gas from Yamal LNG to Europe without stopping in Murmansk. Some vessels also sail eastward via the NSR towards the Bering Strait and south to Asian destinations.

Oil tanker traffic in this area is relatively stable throughout the year, with 40 to 60 tanker transits recorded each month across the western Pechora Sea (Figure 14). Traffic tends to be stable from year to year, with some variations influenced by ice conditions and choice of route—through the Kara Strait or around Cape Zhelaniya, north of Novaya Zemlya, en route to the Barents Sea.

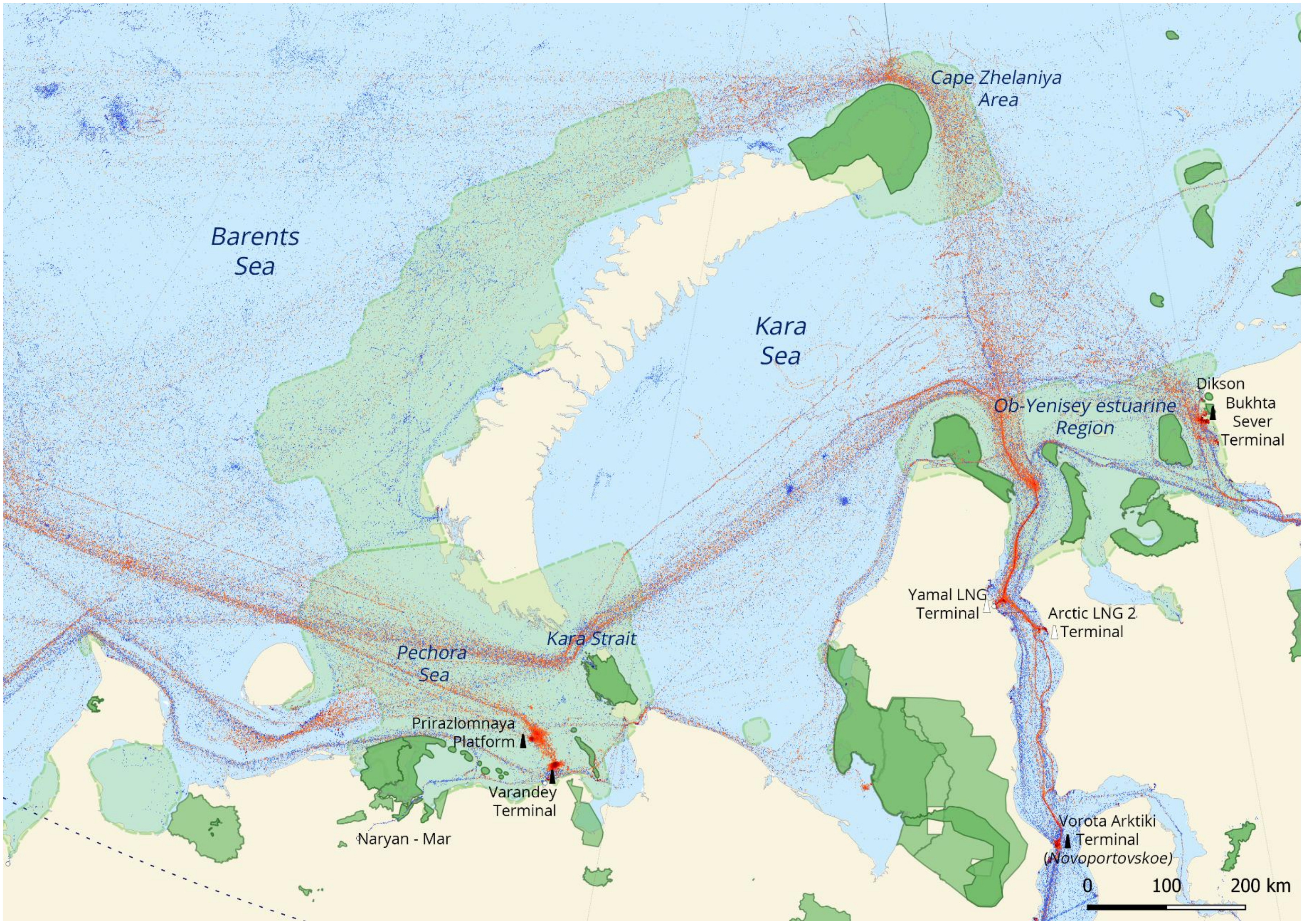

Figure 13: Shipping traffic in the Kara Sea and eastern Barents Sea in 2024. Note: Red dots indicate AIS signals from vessels linked with the oil and gas sector; blue dots indicate AIS signals from all other vessel types except fishing ships; dark blue polygons indicate coastal protected areas; light blue polygons indicate ArcNet priority areas for conservation. *Source*: Global Fishing Watch (2022).

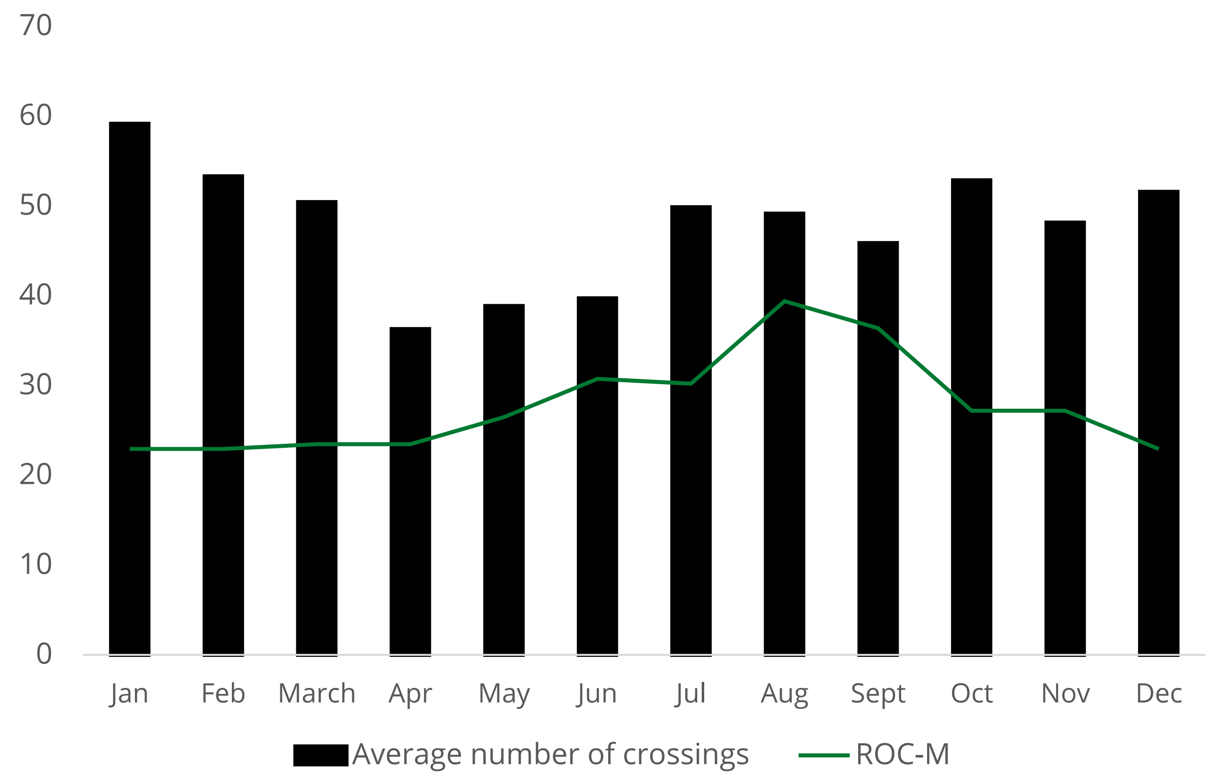

Figure 14: Seasonal dynamics of crude oil tanker crossings and monthly conservation concern levels in the Pechora Sea area, 2018–2024. *Sources*: PAME ASTD, ArcNet.

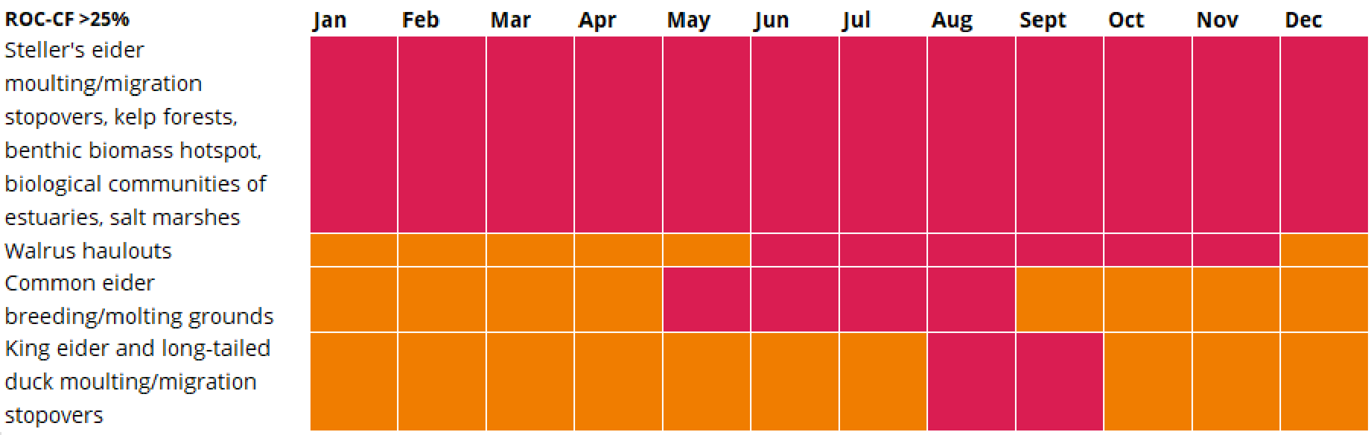

Figure 15: Key biodiversity features in the Pechora Sea with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Source*: ArcNet.

The biodiversity of the Pechora Sea is highly vulnerable year-round to the impacts of oil transport, including both operational risks and possible spills (Figure 15). The level of concern is particularly high in August and September, when biological activity peaks and the potential consequences of spills are greatest. Other biodiversity features that are vulnerable to the impacts of oil and gas–related shipping include extensive kelp forests and coastal salt marshes.

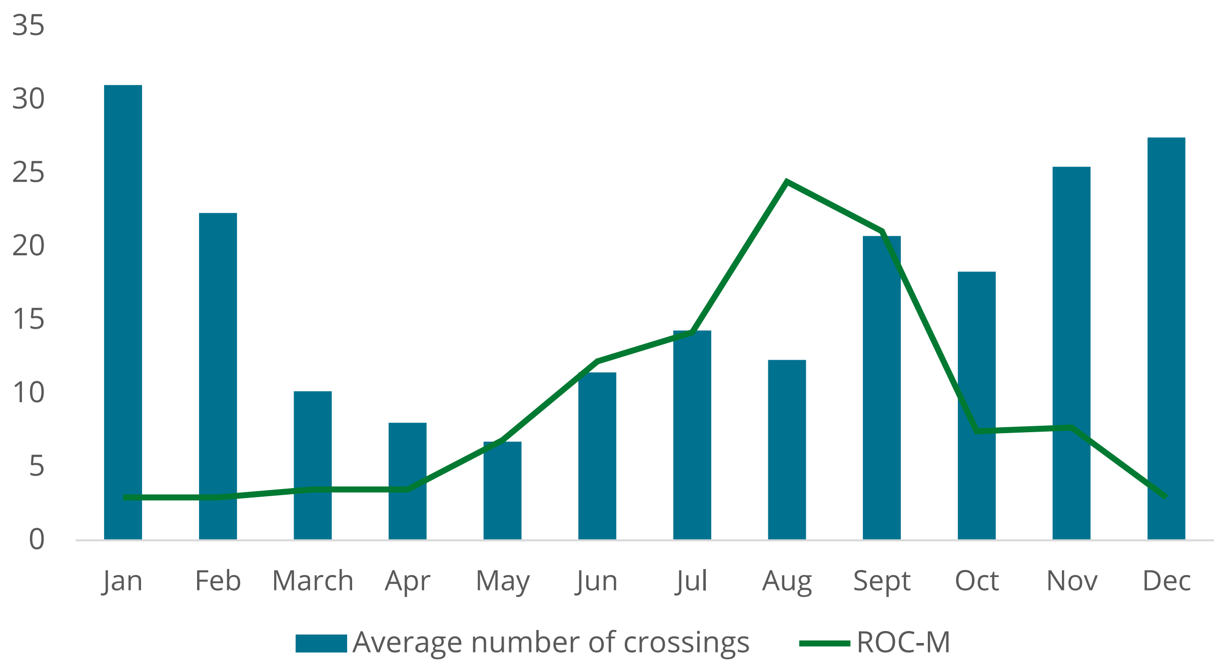

Figure 16: Seasonal dynamics of LNG carrier crossings and monthly conservation concern levels in the Pechora Sea area, 2018–2024. *Sources*: PAME ASTD, ArcNet.

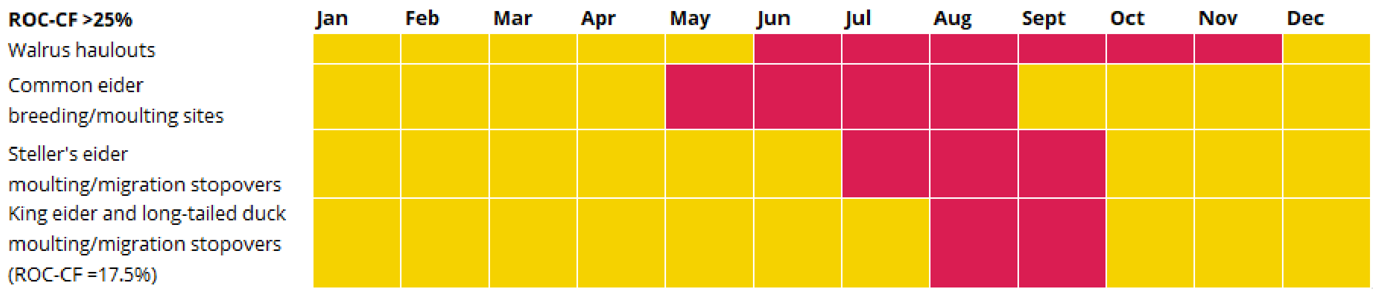

Figure 17: Key biodiversity features in the Pechora Sea with highest level of conservation concern from LNG carrier traffic grouped by months. Red indicates a significant level of conservation concern, with risks from transiting through the habitat area during the specified months considered non-mitigable. Yellow indicates a minor level of conservation concern, with risks from passing through the habitat area during the specified months considered mitigable by adhering to existing environmental standards and best practices. *Source*: ArcNet.

LNG carriers traverse the Kara Strait and Pechora Sea year-round (Figure 16). The traffic intensity in the region drops to its lowest levels (six or seven crossings per month) from March to May, when the ice conditions are most challenging and vessels take the route around Cape Zhelaniya to avoid the strait. In June, when ice conditions stabilize, the LNG carriers return, peaking from November to January with 25 to 30 crossings per month.

The species most affected by LNG carrier traffic during these months are eiders, long-tailed ducks and walrus. Conservation concern levels are highest in August and September (Figure 17).

Cape Zhelaniya

The territorial waters (12 nautical miles) around Cape Zhelaniya, part of the Russian Arctic National Park, provide important habitat for walruses and polar bears (*Ursus maritimus*) and support both breeding colonies and foraging areas for little auks (*Alle alle polaris*). Beluga whales migrate seasonally between the Barents and Kara seas through this area. The presence of recurring polynyas and the marginal ice zone further enhance the area's ecological significance, creating favourable conditions for a wide range of marine life.

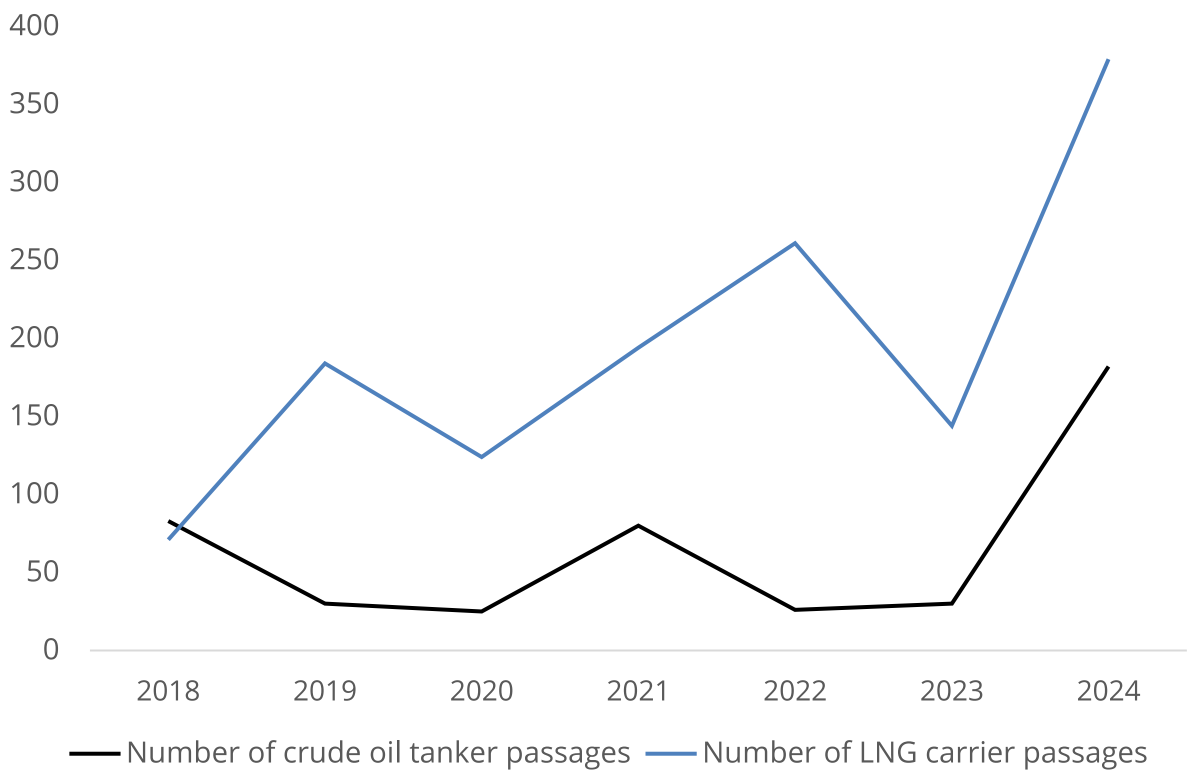

Figure 18: Number of LNG carrier and crude oil tanker passages around Cape Zhelaniya, 2018–2024. *Source:* PAME ASTD (2025).

This area is also becoming increasingly important for oil and gas transportation, with vessel traffic rising sharply—from fewer than 50 oil tanker transits in 2023 to almost 200 in 2024, and from around 150 LNG carriers to more than 350 during the same period (Figure 18). Unlike the Kara Strait and Pechora Sea, which are primarily used by oil tankers, Cape Zhelaniya is dominated by LNG carrier traffic.

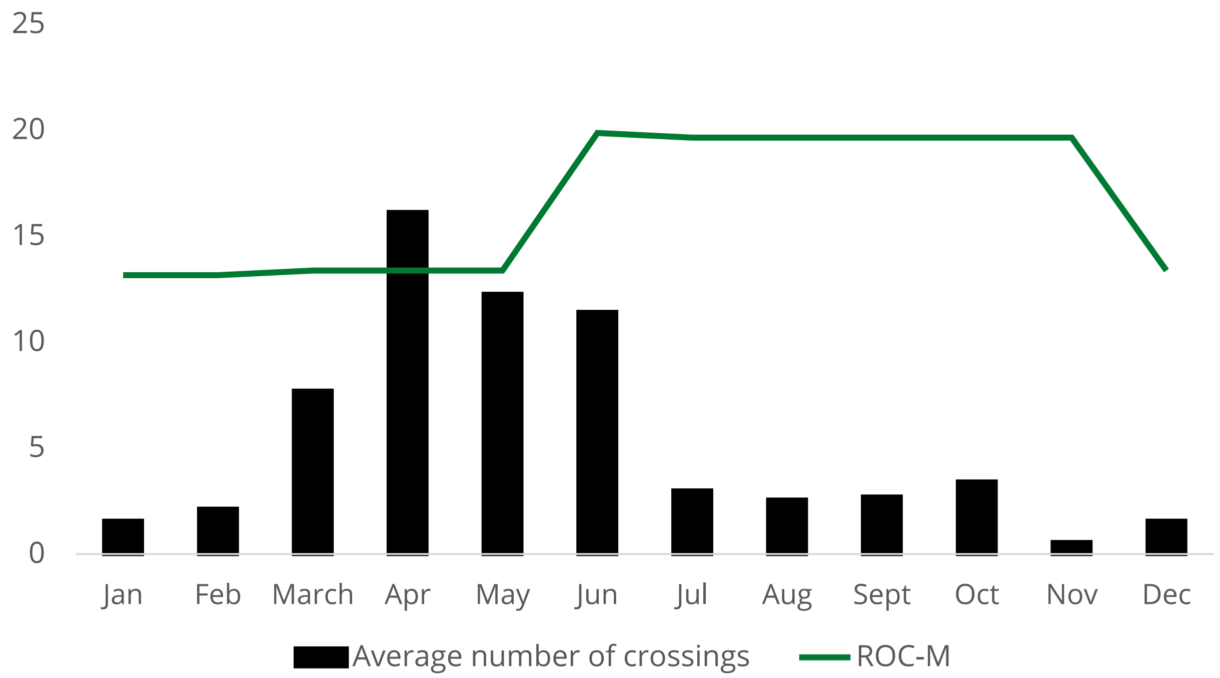

Figure 19: Seasonal dynamics of crude oil tanker crossings and monthly conservation concern levels in the Cape Zhelaniya area, 2018–2024. *Sources*: PAME ASTD, ArcNet.

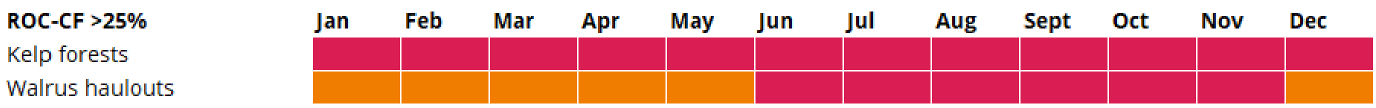

Figure 20: Key biodiversity features in the Cape Zhelaniya area with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Source*: ArcNet.

Crude oil tanker and LNG carrier traffic peaks in this area from April to June, when ice conditions become more favourable compared to conditions in the Kara Strait area (Figures 19 and 21). This is also the season when the marginal ice zone is located within the area, meaning that the concentration of marine life is highest here during these months. Not much research on biodiversity distribution has been conducted during this time of year in this area; this represents a major knowledge gap that should be addressed as soon as possible. Oil tanker activity remains minimal during the rest of the year, with fewer than five crossings per month, while LNG carrier traffic is more stable, with a tendency to increase during the spring months. On average, there are more than 10 crossings per month, with up to 30 per month from March to May (Figure 18).

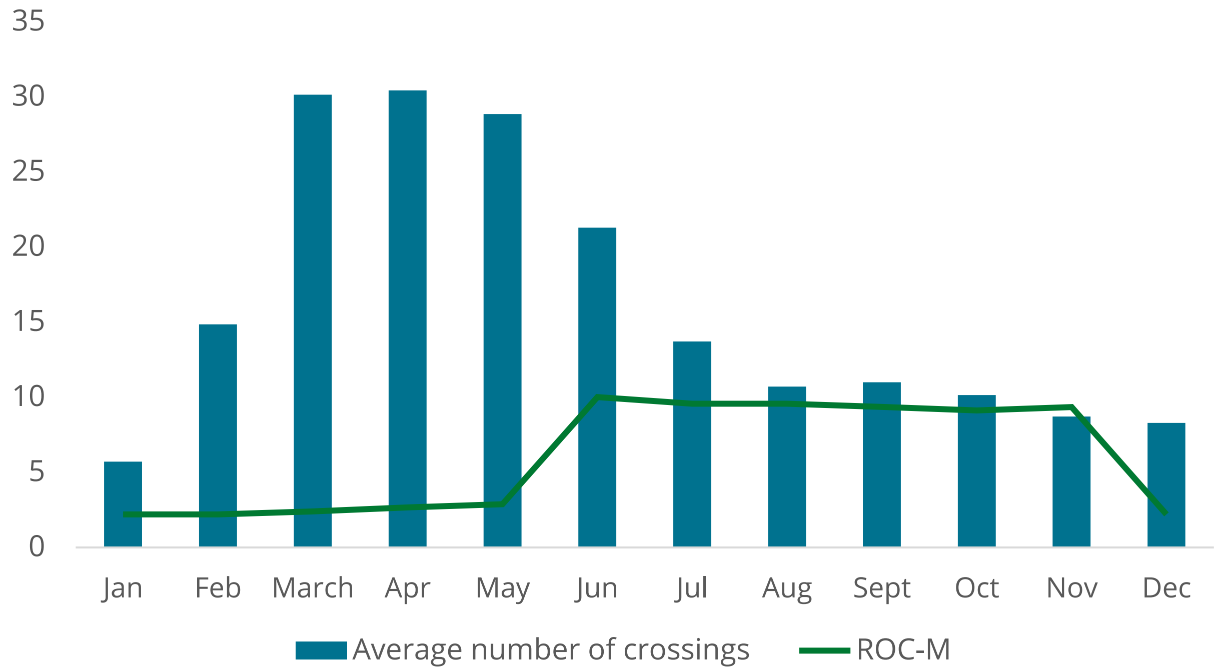

Figure 21: Seasonal dynamics of LNG carrier transits and monthly conservation concern levels in the Cape Zhelaniya area, 2018–2024. *Sources*: PAME ASTD; ArcNet.

Figure 22: Key biodiversity features in the Cape Zhelaniya area with highest level of conservation concern stemming from LNG carrier traffic grouped by months. Red indicates a significant level of conservation concern, with risks from transiting through the habitat area during the specified months considered non-mitigable. Yellow indicates a minor level of conservation concern, with risks from passing through the habitat area during the specified months considered mitigable by adhering to existing environmental standards and best practices. *Source*: ArcNet.

Currently, ships stay about 12 nautical miles from shore when navigating around Cape Zhelaniya. Walrus haulouts and the adjacent walrus habitats appear to be most affected by LNG carrier traffic in this area from June to November (Figure 22). The patterns and scales of marine mammal presence in the marginal ice zone in spring months—as well as of beluga whale migration around Cape Zhelaniya—are not well enough understood yet to yield definitive assessments of the potential impacts. In the case of oil spills or other accidents in remote areas, the lack of emergency preparedness and response infrastructure would pose a significant challenge to organizing clean-up operations.

The Ob–Yenisey estuarine region

The Ob–Yenisey area is characterized by high biological productivity associated with the estuarine front in the outer part of the Gulf of Ob. The area hosts key year-round and seasonal habitats for several Arctic species, including whitefish, beluga whales and ringed seals.

Some parts of the area, particularly those along the eastern coast of the Gydan Peninsula and the islands within nature reserves, are minimally affected by human activity. However, intensive navigation in the Gulf of Ob and Yenisey Bay increases the vulnerability of these parts of the region. Today, the Gulf of Ob is the area with the greatest shipping intensity along the NSR (Figure 23). The number of passages through the gulf is growing. In 2024, several oil tankers and LNG carriers passed through the gulf each day (Figures 24 and 26).

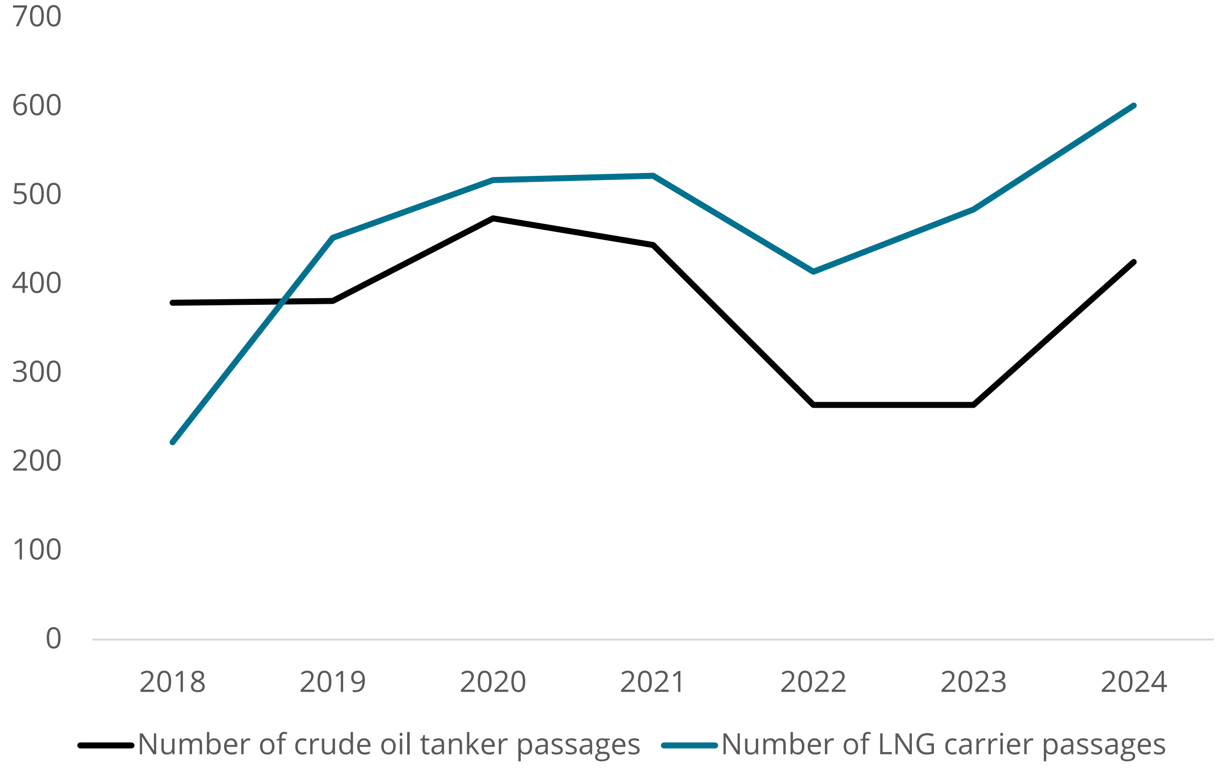

Figure 23: Number of LNG carriers and crude oil tanker passages through the Gulf of Ob, 2018–2024. *Source:* PAME ASTD (2025).

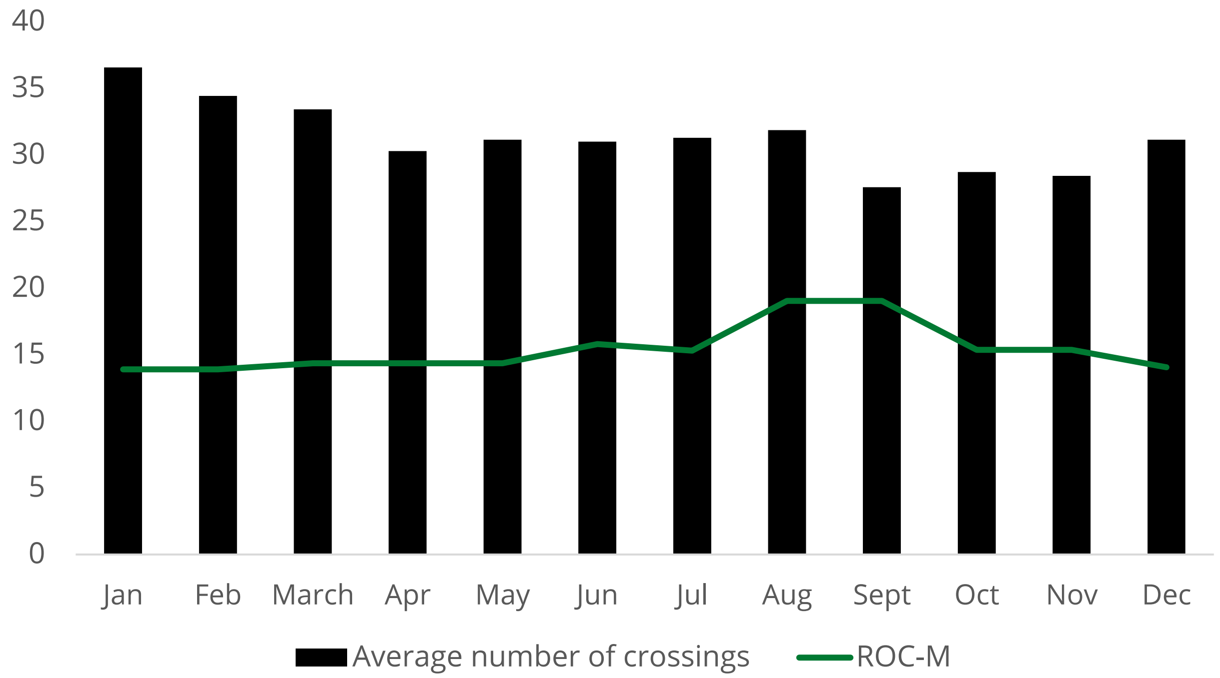

Figure 24: Seasonal dynamics of crude oil tanker crossings through the Gulf of Ob and monthly conservation concern levels in the Ob–Yenisey estuarine region, 2018–2024. *Sources*: PAME ASTD, ArcNet.

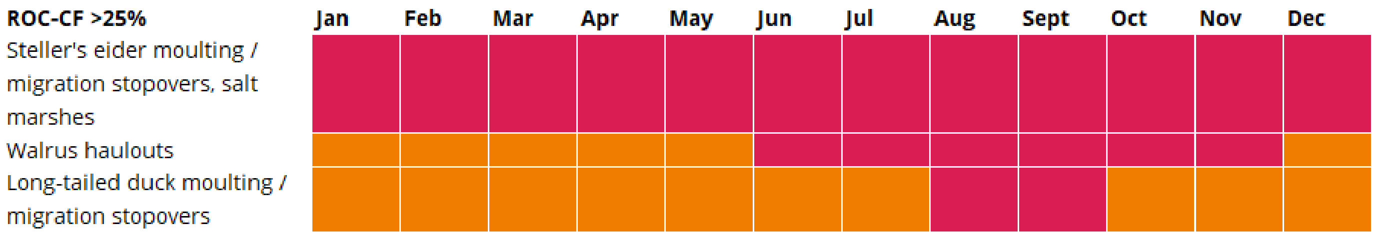

Figure 25: Key biodiversity features in the Ob–Yenisey estuarine region with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Source*: ArcNet.

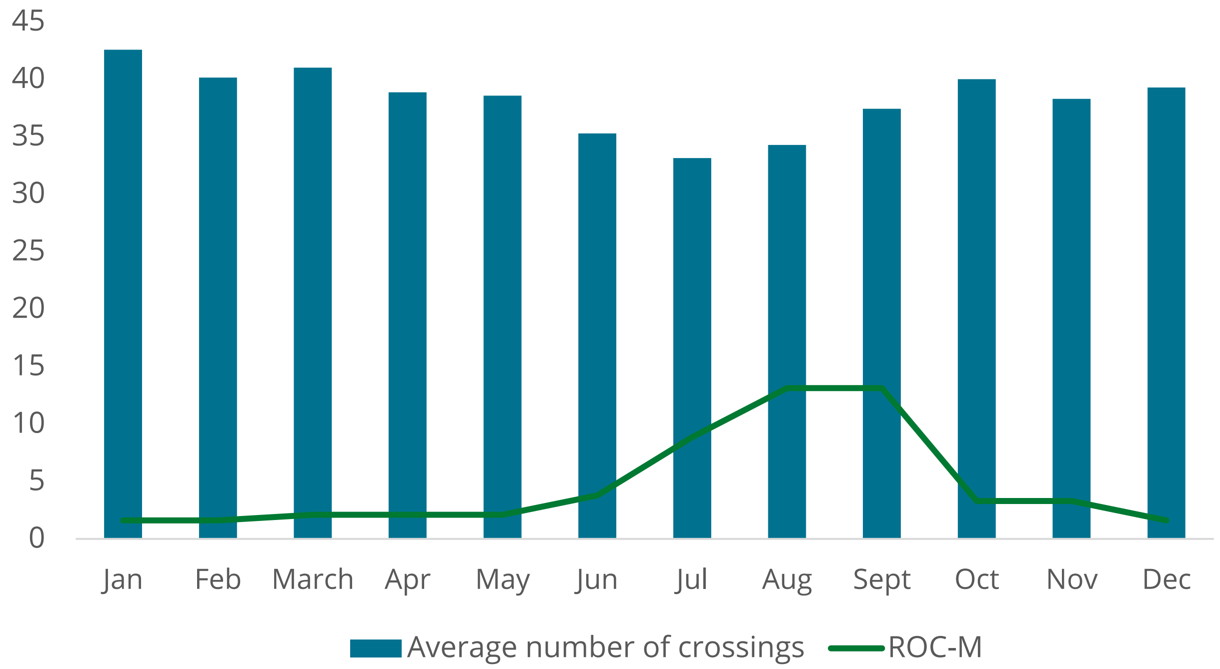

Figure 26: Seasonal dynamics of LNG carrier crossings through the Gulf of Ob and monthly conservation concern levels in the Ob–Yenisey estuarine region, 2018–2024. *Source*: PAME ASTD, ArcNet.

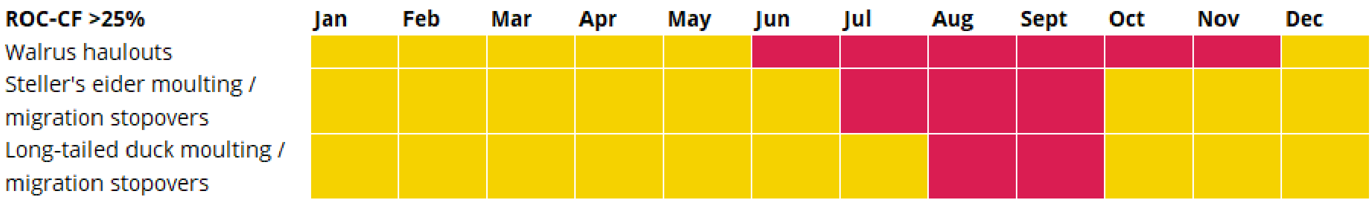

Figure 27: Key biodiversity features in the Ob–Yenisey estuarine region with highest level of conservation concern stemming from LNG carrier traffic grouped by months. Red indicates a significant level of conservation concern, with risks from transiting through the habitat area during the specified months considered non-mitigable. Yellow indicates a minor level of conservation concern, with risks from passing through the habitat area during the specified months considered mitigable by adhering to existing environmental standards and best practices. *Source*: ArcNet.

Among the species most vulnerable to the impacts of shipping are eiders, long-tailed ducks, and walrus that frequent a small haulout site in the outer part of the area (Figures 25 and 27). Siberian sturgeon (*Acipenser baerii*) and other fish species inhabiting the estuary are also exposed to traffic risks because the gulf provides key nursery and feeding grounds for them.

The level of conservation concern is high with respect to oil tanker traffic (Figure 24), but low to medium with respect to LNG carrier traffic (Figure 26). Walrus haulouts are affected by both oil tankers and LNG carriers, whereas for Steller's eiders, oil tankers pose a higher risk.

However, these assessments do not consider the impacts of dredging. To allow the passage of large oil tankers and LNG carriers across the shallow bar in the outer part of the Gulf of Ob, a channel was dredged to a depth of 15 metres. The channel is more than 50 kilometres long and almost 500 metres wide. The total volume of dredged material exceeded 32 million cubic metres.[10] The channel's construction and maintenance has disrupted the delicate balance between the freshwater outflow from the river and the saline waters of the Kara Sea (Spiridonov et al., 2020).

In addition to dredging, maintenance of the open-water channel through the ice during winter, physical disturbance, and light and noise pollution from ships (including support vessels, tugs and icebreakers) are some of the main factors affecting marine and coastal life. These disturbances are significant long-term influences that are altering the ecosystem of the gulf. The construction of the oil terminal in Yenisey Bay (the new port of Bukhta Sever) adds to the shipping pressure in these areas, given the many dredging and other vessels involved in building the new port and improving nearby navigation conditions as well as the intensive tanker traffic expected after completion.

Much of the damage to the Ob–Yenisey estuarine region has already occurred. To minimize further impacts, efforts should focus on compensatory measures, such as establishing protection for areas that remain relatively undisturbed and designating additional protected areas in other Siberian estuarine systems.

It will also be important to ensure that the ongoing construction in Yenisey Bay does not lead to ecosystem degradation similar to that observed in the Gulf of Ob.

The Norwegian Sea and the Barents Sea

The marine area of the Barents Sea extending along the Scandinavian coast from Vestfjorden (Norway) in the southwest to the western Kola Peninsula (Russia) in the northeast has been identified by ArcNet as a PAC. Key biodiversity features include the world's largest cold-water coral reef complex, extensive seagrass meadows, and kelp forests in shallow coastal zones. The area contains migration routes for pink salmon (*Oncorhynchus gorbuscha*) and European eel (*Anguilla anguilla*) as well as feeding grounds for Arctic char (*Salvelinus alpinus*) and Atlantic salmon (*Salmo salar*). These waters are also frequented by numerous cetaceans, including minke whales (*Balaenoptera acutorostrata*), humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), and fin whales (*Balaenoptera physalus*) as well as orcas (*Orcinus orca*) and white-beaked dolphins (*Lagenorhynchus albirostris*). The region supports substantial populations of grey seals (*Halichoerus grypus*), while coastal cliffs and islands host Europe's largest seabird colonies.

[10] See Decision by the Rosmorport, January 22, 2014. Available at https://www.rosmorport.ru/media/File/arf/eco/Reshenie_vodop_22012014.pdf

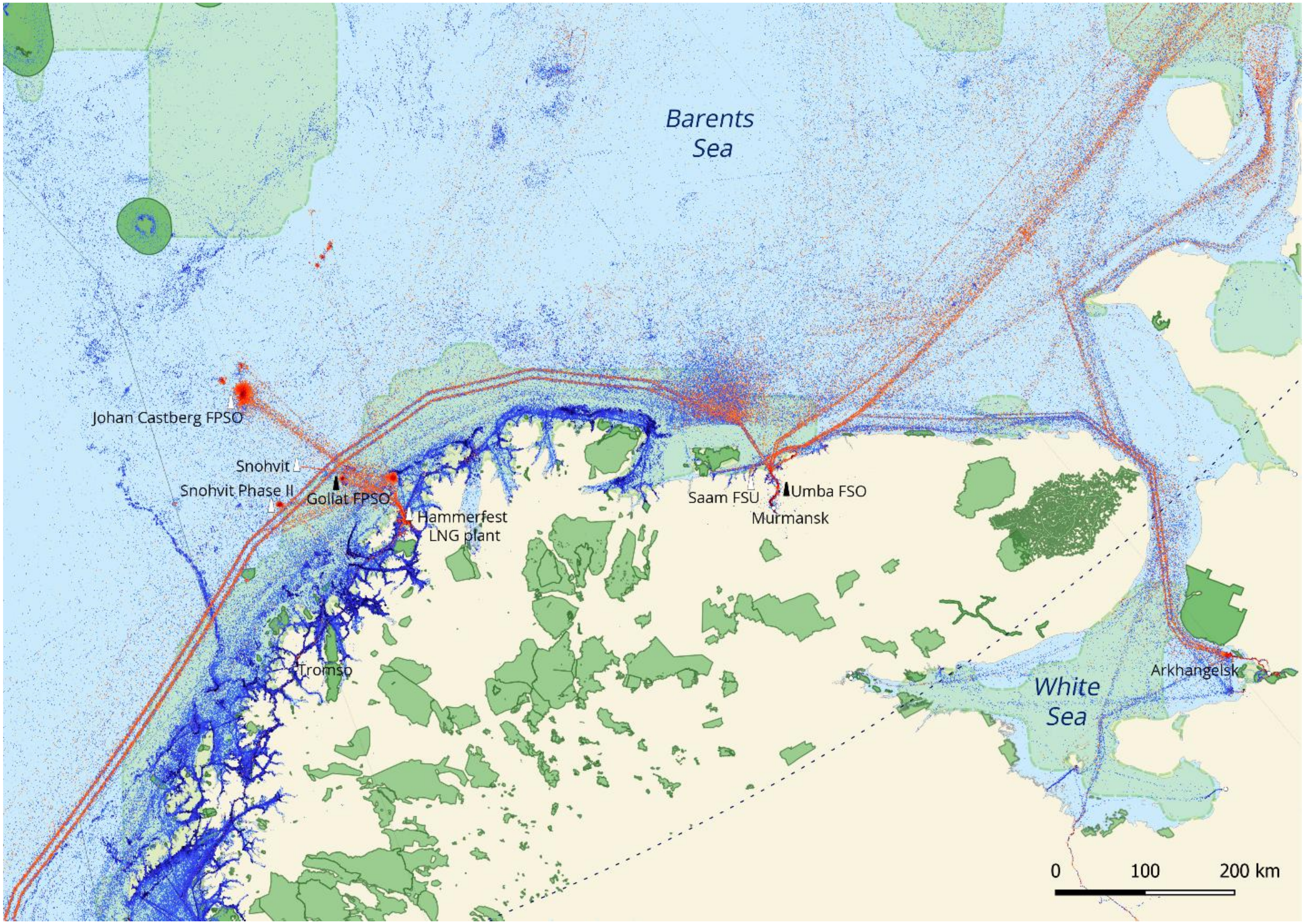

Figure 28: Shipping traffic in the Norwegian Sea–Barents Sea area in 2024. Note: Red dots indicate AIS signals from vessels linked with the oil and gas sector; blue dots indicate AIS signals from all other vessel types except fishing ships; dark blue polygons indicate coastal protected areas; light blue polygons indicate ArcNet priority areas for conservation. *Source*: Global Fishing Watch (2022).

The Norwegian coast in the Barents Sea is the most commercially developed and exploited area in the entire Arctic. It is characterized by large urban centres, extensive infrastructure, a substantial human population, and active coastal industries, including aquaculture, fisheries and mining. The region also experiences intensive cabotage shipping (domestic transport between local ports), represented by the blue dots on the Figure 28 map and penetrating into the coastal areas of fjords and rivers. A steady procession of oil and gas tankers delivers products from fossil fuel production sites in the Norwegian waters of the Barents Sea (the Goliat and Johan Castberg projects) and the LNG terminal in Hammerfest. In addition, tankers carrying oil and gas products from Murmansk are shown as the two parallel trajectories running along the Scandinavian coast.

Although this region is captured on the map as a single PAC, we suggest looking more closely at two distinct subregions within it that are distinguished by their oil and gas production and shipping patterns. These are the Kola Peninsula area and the Norwegian coastal waters area.

The Kola Peninsula

Shipping traffic along the Kola Peninsula area is primarily driven by Murmansk, the biggest city above the Arctic Circle and a major port for oil and gas exports. In 2024, traffic passing through the Kola Bay entrance was dominated by oil tankers (Figure 29). Ships coming to Murmansk often spend significant time outside Kola Bay waiting to unload (see Figure 28, where the cloud of red dots indicates vessels waiting their turn).

The level of conservation concern for this area is very high (Figures 30 and 31). Nearly all of the key Arctic biodiversity features identified in this area—eiders, long-tailed ducks and kelp forests—are highly sensitive to the risks associated with oil transportation.

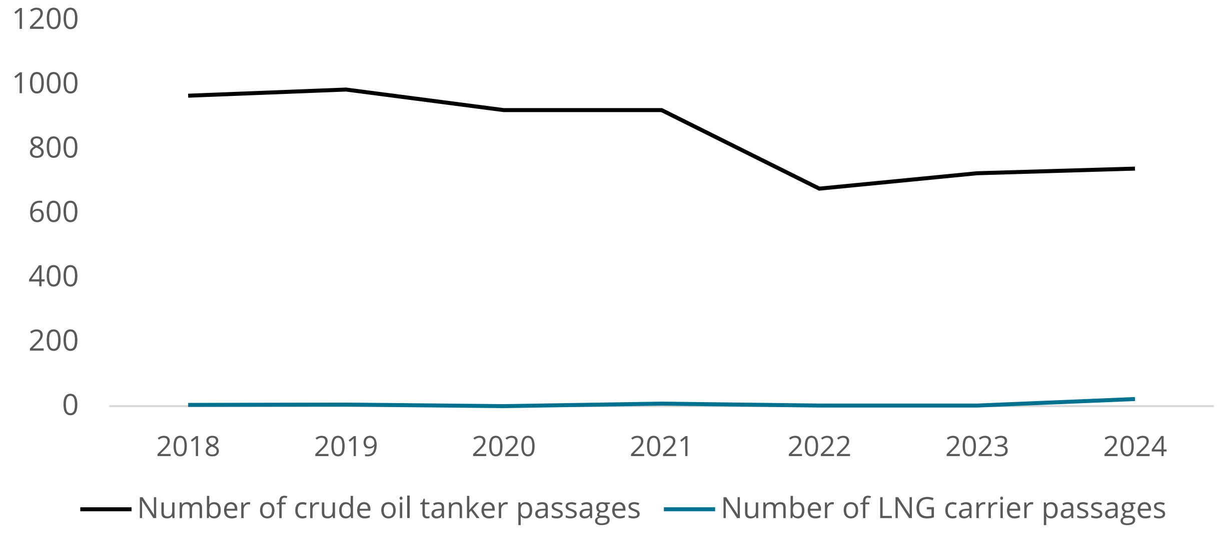

Figure 29: Number of LNG carrier and crude oil tanker passages through the Kola Bay entrance, 2018–2024. *Source:* PAME ASTD (2025).

LNG carriers are rarely present in Kola Bay itself. Those that do enter the area sail to a large floating storage facility located in Ura Bay, west of Kola Bay. They deliver LNG produced in the Gulf of Ob.

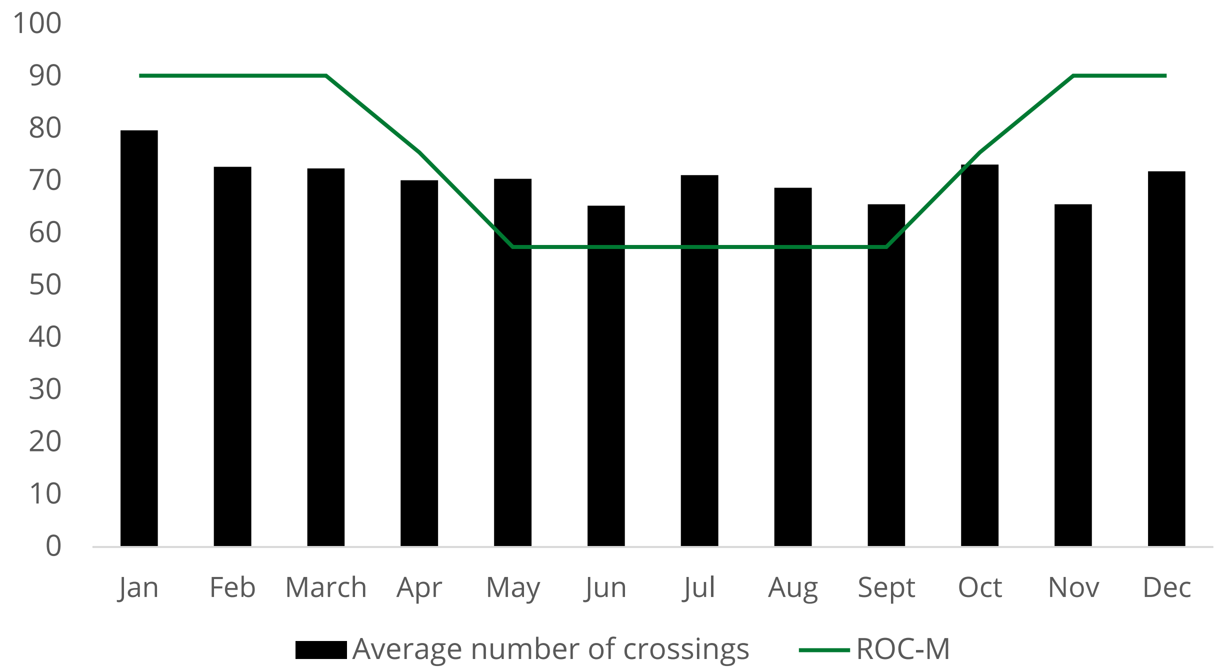

Figure 30. Seasonal dynamics of crude oil tanker crossings and monthly conservation concern levels in the Kola Bay area, 2018–2024. *Sources*: PAME ASTD, ArcNet.

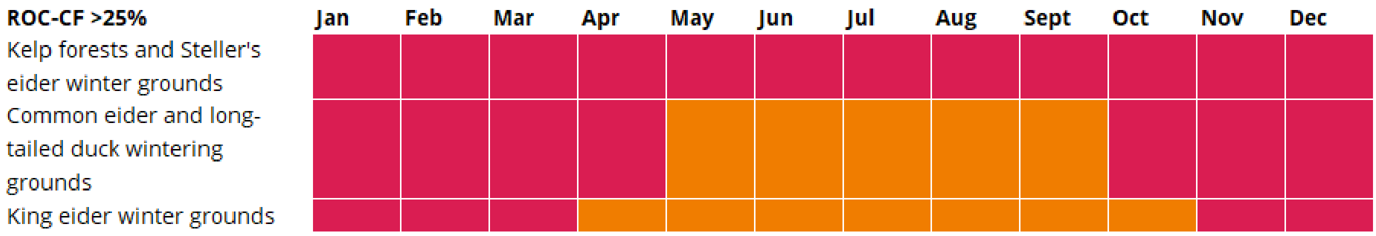

Figure 31: Key biodiversity features in the Kola Bay area with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red shading indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Source*: ArcNet.

Norwegian coastal waters

The number of LNG carriers sailing in Norwegian coastal waters has increased steadily since 2022, whereas the number of crude oil tankers has been declining (Figure 32). The number of oil tankers remained relatively steady throughout the entire year, with 22 to 27 tankers per month (Figure 33). The number of LNG carriers was highest from December to April (Figure 35). These tankers and carriers travel close to the boundaries of the coastal area identified by ArcNet as a PAC (see the two red lines showing the moving trajectory of vessels, Figure 28).

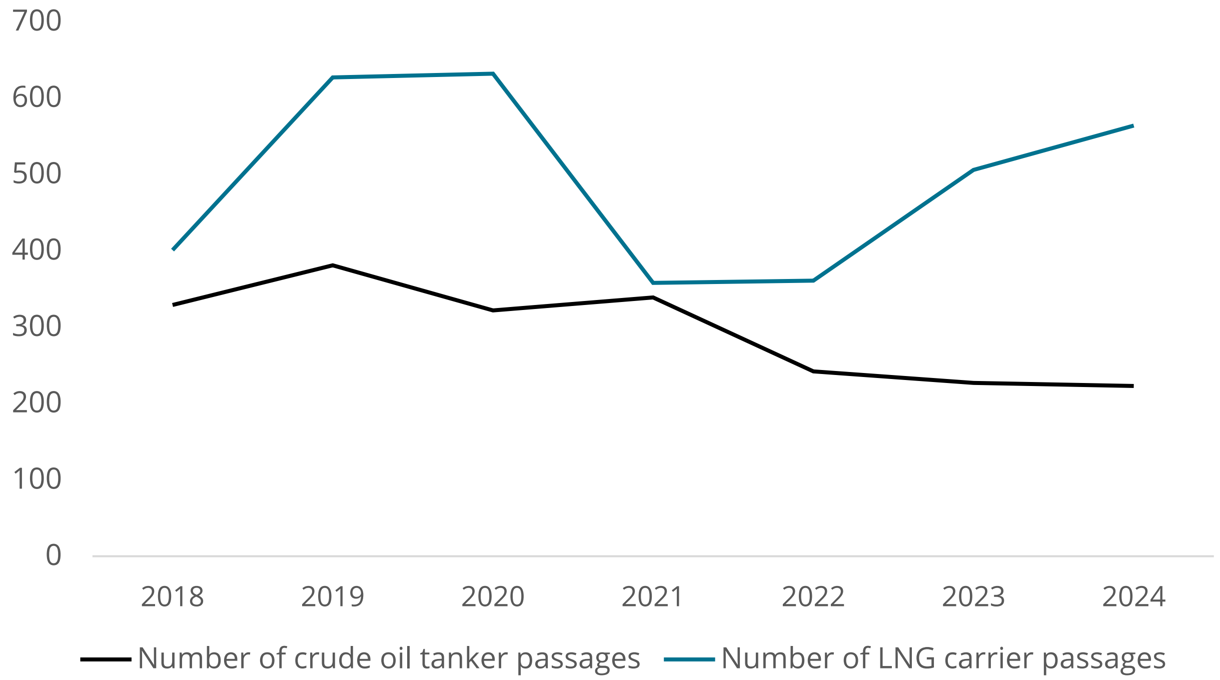

Figure 32: Number of LNG carriers and crude oil tanker passages through the Norwegian coastal waters, ArcNet priority area for conservation 27, 2018–2024. *Source:* PAME ASTD (2025).

Oil tankers pose higher risks than LNG carriers to the biodiversity features identified as priorities for conservation in this area (Figures 33 and 35). These risks come from potential oil spills, increased levels of underwater radiated noise, and water and air pollution from the use of scrubbers and residual fuels. Tankers with Norwegian oil platforms in the Barents Sea (Goliat and Johan Castberg) are 10 years younger, on average, than those operating out of Murmansk (17 years, on average). All are double-hulled, in accordance with IMO requirements for vessels with more than 5,000 gross tonnage.

The biodiversity features most at risk from the impacts from oil tankers in this area are the Steller's eider and king eider wintering grounds, cold-water corals, kelp forests, long-tailed duck, and humpback whale summer feeding grounds (Figure 34).

While the LNG carriers pose less pollution risk than oil tankers, they are associated with an elevated threat of marine mammal strikes due to their higher average speed (15 knots), which is faster than recommended for areas where mammals are present.

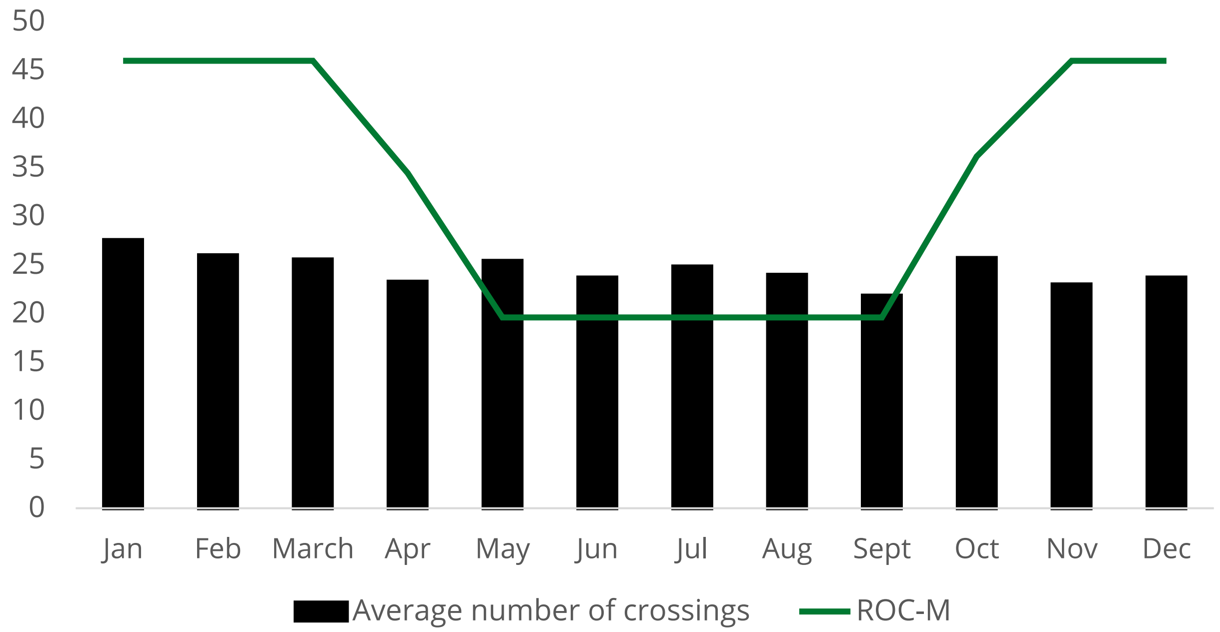

Figure 33: Seasonal dynamics of crude oil tanker crossings and monthly conservation concern levels in the Norwegian coastal waters, 2018–2024. *Sources*: PAME ASTD, ArcNet.

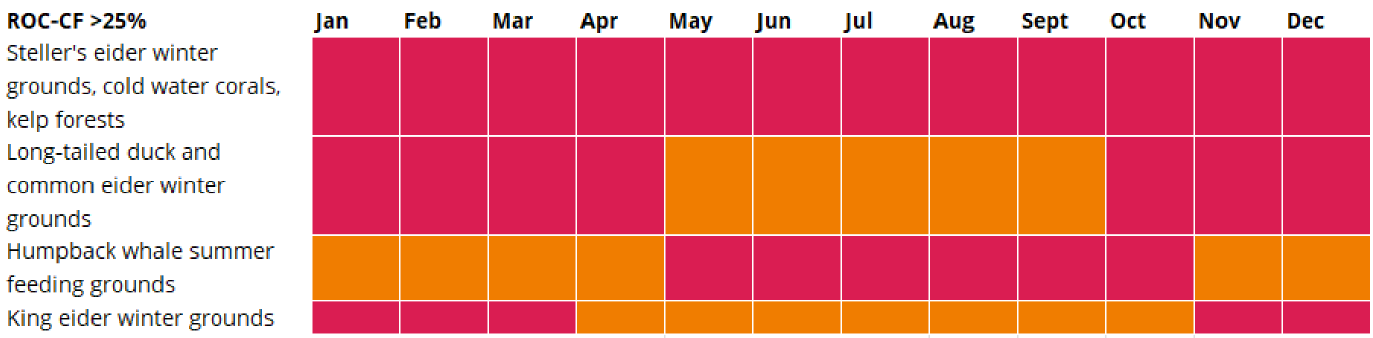

Figure 34: Key biodiversity features in the Norwegian coastal waters area with highest level of conservation concern stemming from oil tanker traffic grouped by months. Red indicates a significant level of conservation concern, with risks from oil transportation through the habitat area during the specified months considered non-mitigable. Orange indicates a notable level of conservation concern, with risks from oil transportation through the habitat area during the specified months requiring mitigation through activity-specific or habitat-specific measures. *Source*: ArcNet.

The carriers linked with the Snøhvit gas field in the Barents Sea export liquefied gas from the Hammerfest LNG terminal on the island of Melkøya, Europe's largest LNG export facility. The island is part of a coastal ecosystem that harbours salmon habitats and farms. It is also home to the Indigenous Sámi people, whose livelihoods and cultural practices depend on the well-being of these ecosystems.

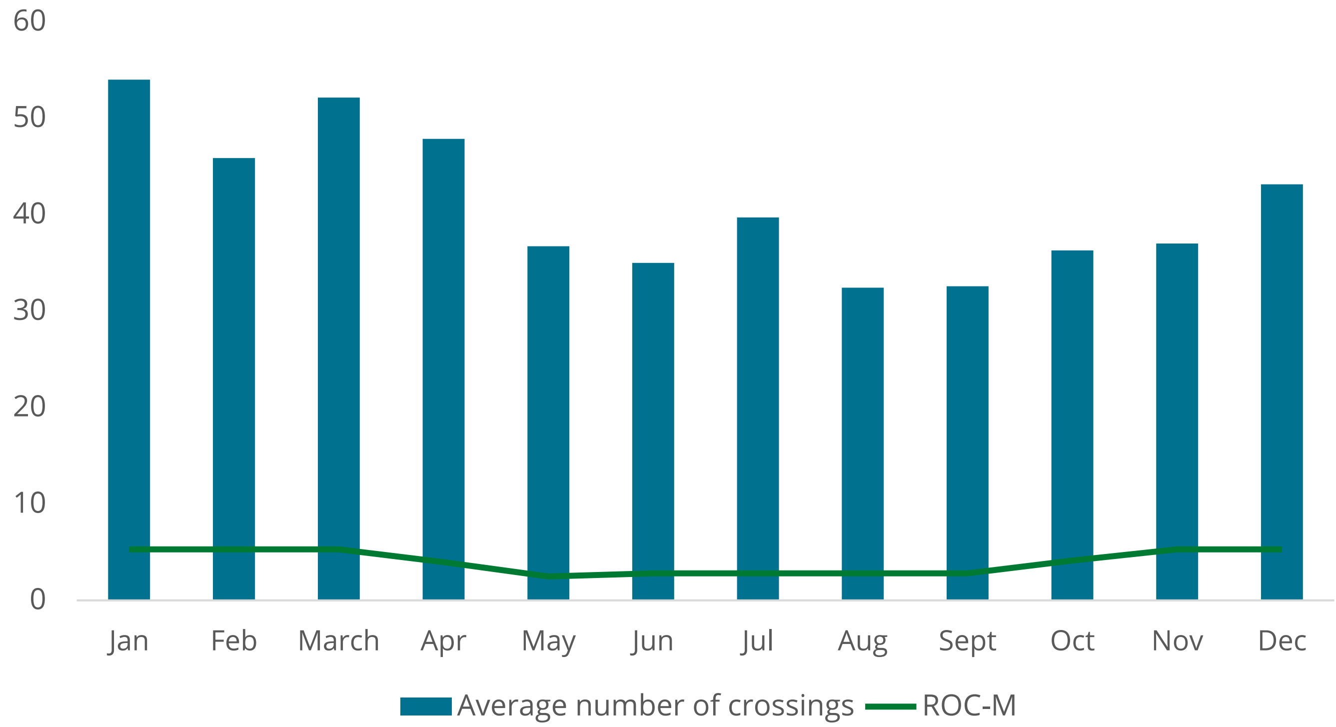

Figure 35: Seasonal dynamics of LNG carrier crossings and monthly conservation concern levels in Norwegian coastal waters, 2018–2024. *Sources:* PAME ASTD, ArcNet.

5. Conclusion

Our analysis linking shipping activity with Arctic oil and gas projects—and situating this within regional biodiversity patterns—reveals clear seasonal trends in both shipping traffic and marine life distribution.

For ships delivering oil and gas products from production sites in the Ob–Yenisey estuarine region of Russia, there is westbound and eastbound seasonality. For oil tankers and LNG carriers travelling eastward via the NSR and Bering Strait, the busiest times of the year are the summer and fall months (June to late October). In winter and spring, the numbers of these vessels drop to virtually zero. The westbound route passing through Novaya Zemlya, the Barents Sea, and along the ice-free Norwegian coast is busy throughout the year, although LNG carrier traffic shows some seasonal variation: more LNG carriers travel westbound during the winter and spring months (December to April), with their numbers decreasing in summer and early fall. This can be attributed to these carriers heading eastward via the NSR when the route becomes ice-free.

The seasonal variation in the intensity of shipping traffic linked with oil and gas projects has implications for marine life. When increased traffic coincides with the migration of marine mammals through these waters, the risks of strikes and impacts of underwater radiated noise increase.

The types of vessels and their characteristics also matter. Oil tankers operating on residual fuels and using scrubber systems are the biggest source of both underwater noise and water and air pollution, including black carbon. Around 150 oil tankers in all regional areas of interest were linked with oil and gas projects in 2024. Switching these vessels from residual to polar fuels (including distillate fuels, such as DMA and DMZ) would reduce their black carbon emission levels. Moreover, replacing older tankers with newer vessels—such as those that meet the IMO's latest recommendations on best available technologies for energy efficiency and noise reduction—would reduce carbon emissions and help safeguard ocean health.

There also remains a serious lack of infrastructure and capacity for effective spill and incident response. This means safer, newer vessels are needed to operate in these hazardous waters.

Besides technological improvements that can reduce the levels of underwater radiated noise,[11] operational measures specific to each subregion are also important for reducing shipping impacts. These include integrating biodiversity data in voyage planning, slow steaming, rerouting whenever possible to avoid contact with migrating mammals, and dynamic measures informed by real time and seasonal biodiversity data available to mariners on the bridge.

For the 50-plus LNG carriers linked with Arctic gas projects, the main biodiversity impacts stem from their average speed of 14 to 15 knots. These comparatively fast speeds increase the level of underwater radiated noise and raise the risk of strikes. In the Bering Strait, such operating speeds represent a significant concern and require urgent action. As mentioned earlier, an IMO-endorsed traffic separation scheme is in place in the area, and the distinctive vessel-movement patterns

[11] The improvements may include optimizing propeller design to reduce cavitation, retrofitting louder machinery components with quieter types, or making design improvements recommended by the IMO. See the IMO's 2024 Marine Environment Protection Committee (MEPC) *Revised Guidelines for Underwater Radiated Noise from Shipping*.

observed in 2024 indicate that most ships follow these voluntary routing measures. Yet vessel speeds remain high, especially for LNG carriers.

While oil tankers and LNG carriers are the most visible sources of concern, oil and gas–related shipping extends far beyond these. The hydrocarbon projects generate extensive additional traffic in the form of multipurpose vessels, tugs, dredgers, icebreakers, cargo vessels and more. It is important to monitor both the scale and impacts of their activities as well as their characteristics and operating conditions. The operations of dredging vessels to improve navigation in shallow waters or build new oil terminals is also a source of seabed and coastal habitat degradation and underwater noise. Given that more dredgers are expected to join the Arctic fleet in the future to assist in building new deep-water ports and infrastructure, this activity requires more scrutiny.

Two other important considerations for minimizing the impacts of shipping on marine life are climate change and ecosystem responses. As Arctic ecosystems continue to change under the influence of climate warming, there is an urgent need for further research and monitoring to understand how migration routes and other key habitats are shifting. The ecosystems affected by oil and gas–related shipping are among the least studied, even after accounting for a recent increase in research. Research focusing on the distribution and seasonal patterns of key species and biological communities, as well as the establishment of systematic monitoring, is urgently needed.

Across the subregions considered in this report, several benthic-feeding species (walrus, eiders and long-tailed ducks) and coastal habitats (salt marshes and kelp forests) are particularly vulnerable to the effects of oil transportation. Additional efforts should be made to monitor their distribution and how shipping may affect them. Because these species and habitats are well-defined and occur in spatially concentrated areas, they are good candidates for area-based conservation measures.

A closer look at the areas of interest—the Bering Strait, the Kara Sea and eastern Barents Sea, and the Norwegian coast—and their associated PACs demonstrates the need for targeted research to assess how ongoing oil and gas operations and shipping affect these and other areas. This knowledge is needed to inform the development of effective conservation measures specific to particular areas.

Finally, given the current geopolitical situation, filling existing regulatory gaps through new regional or international agreements will be challenging. This makes it all the more urgent for the shipping sector to adopt voluntary measures that will complement, rather than replace, mandatory regulations. Such measures can provide the flexibility and responsiveness—for example, through dynamic or temporary restrictions—that broad, one-size-fits-all regulations sometimes lack.

Ultimately, shippers operating in and near the Arctic should strive to implement the highest safety and environmental standards to protect humans and nature.

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