

The Influence of The "Shadow Fleet" on Ecological Threats In The South Baltic Sea – Simulation Aspect*

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Abstract

The problem of marine pollution is one of the most important topics that concern today's civil societies, especially when it involves uncontrolled sabotage. With this in mind, it was determined that maintaining an appropriate and satisfactory level of cleanliness in the Baltic Sea is a research topic worth exploring. Furthermore, it was noted that, while there is a considerable amount of research material in this area, there is a significant gap in the context of the so-called „shadow fleet”. This gap undoubtedly stems from the topic's inherent incompetence, which is why this study attempts to present a different perspective – a simulation of the existing ecological threat in the South Baltic area.

Therefore, the main goal of this study is to demonstrate the impact of the „shadow fleet” on the ecological threats in the South Baltic area, based on publicly available simulation models, which provide a basis for taking action to counteract any emerging crisis incidents. The study utilized secondary analysis of literature and legislative data in Poland and the European Union, which allowed for the analysis of available data on the impact of the „shadow fleet” on the initiation of ecological threats in the Baltic Sea area. Additionally, the study employed a case study approach, which allowed for the analysis of available simulation models in the context of the impact of the „shadow fleet” activity in the Baltic Sea on the initiation of possible changes in the context of area contamination caused by oil and petroleum spills.

The final section of the study presents important conclusions related primarily to the need to maintain continuous operational readiness and the ability to respond to threats to our marine environment, as well as to implement a support package for naval units from each Baltic state, within their respective competences. The study also revealed that the wars in Ukraine and the Middle East have exposed the problem of uncontrolled vessels, which impact international maritime security.

Keywords: „shadow fleet”, ecological threats to the sea, sustainable development.

Introduction

The Baltic Sea has been considered one of the most crowded water bodies in the world for many years¹. The continuous increase in the number of ships in the Baltic contributed to this², which results from the growing importance of maritime transport³, especially in the recent period, when a significant increase in social unrest caused by geopolitical instability in the world can be observed⁴. Road and rail transport, and especially air

¹ Fabisiak, J. (2008), *Ecological threats to the Baltic Sea related to chemical pollution - hydrocarbons*. Scientific Papers of the Naval Academy, 49, pp. 7-28.

² Pliszczynski, P. (2023), *International maritime transport and global trade, trends and forecasts*. Student Journals „Our Studies”, (13), pp. 40-49.

³ Czaja, P., Boleska, B., (2024), *Smart port – the foundation of modern maritime transport*. Contemporary trends, p. 15.

⁴ www.chronbaltyk.pl/o-baltyku/zagrozenia-i-problemy-morza-baltyckiego/, (access: 3.03.2026 r.).

transport, turn out to be very sensitive to any incidents that occur unexpectedly^{5 6}. An example would be the war in Ukraine⁷, which completely changed the direction of supply chains, or the attack of the United States and Israel on Iran, which led to the disruption of the most important supply corridors⁸. Therefore, maritime transport has become an alternative to the constant closure of airspace or the problems associated with crossing national borders in road traffic, even within the European Union⁹ (Figure 1.).

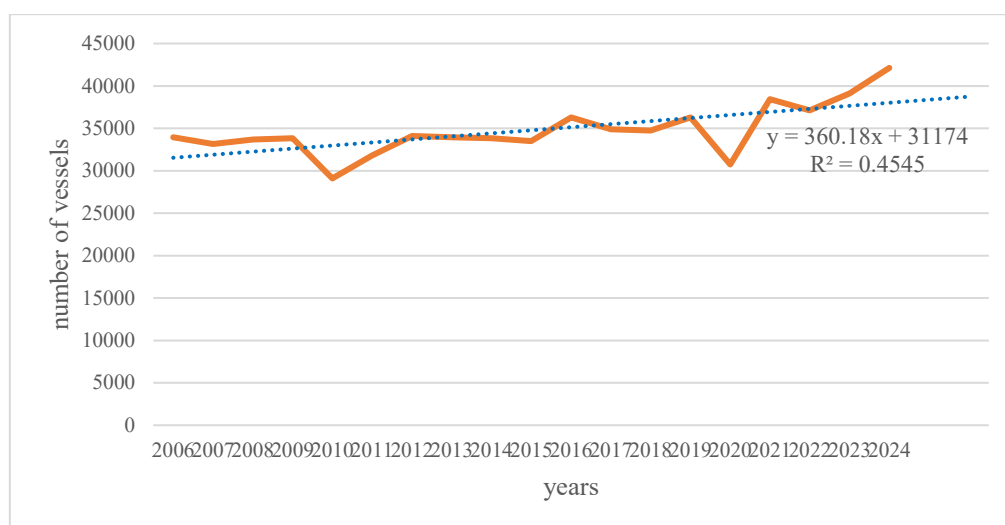


Figure 1. Number of units in the Baltic Sea according to IMO

Source: own study based on: www.maps.helcom.fi (access: 3.03.2026 r.).

It is estimated that maritime transport volume has increased by almost 50% over the last decade and continues to grow¹⁰. This is evidenced by statistics, which show that over 60% of all IMO-registered (International Maritime Organization) ships operating in the Baltic Sea are cargo ships and tankers. These are large vessels, reaching over 300 meters in length (HELCOM 2018). However, the traffic itself exerts considerable pressure on the Baltic Sea environment. Pollution in the marine environment is a result of these ships and is constantly increasing¹¹. These are largely exhaust gases and dust, sewage and feces, although most pollution comes from diesel oil or heavy fuel oil¹², which they use to propel vessels¹³. Their size is so large that in 2005, the Baltic Sea was included in a Sulphur Emission Control Area (SECA). It was the first such area in the world, thanks to which the content of sulphur compounds in fuel was significantly reduced (HELCOM 2018).

⁵ Ochyla, P., Maćkowiak, M., Sadurski, P., (2024), *Assessment of the impact of the COVID-19 pandemic on the aviation industry, including passenger transport, airlines and airport infrastructure*, Law and Security, 2, pp. 181-199.

⁶ Pisarek-Bartoszewski, R., Kornacka, M., (2024), *Passenger and cargo air transport – challenges faced by the COVID-19 pandemic in the light of our own research*, [in]: *The multidimensionality of contemporary challenges in logistics and transport*, University of Lodz Publishing House, Łódź 2024, pp. 30-57.

⁷ Rokicki, T., Surzyński, B., (2023), *The impact of supply chain disruptions during the COVID-19 pandemic and the war in Ukraine on the operation of a commercial enterprise in the construction industry*, Economics and Logistics Organization, 8(3), pp. 81-96.

⁸ www.businessinsider.com.pl/gospodarka/tony-towarow-utknely-na-bliskim-wschodzie-paraliz-na-morzu/zfyzdfff, (access: 3.03.2026 r.).

⁹ Obernikhin, A., Korzeń, E., (2025), *Analysis of the container transport market's response to crises: COVID-19, the Suez Canal blockade (2021) and the Red Sea crisis*, Studies and Papers of the College of Management and Finance, (201), pp. 49-67.

¹⁰ www.pitd.org.pl/reports/pl/pl_0025_Rozdzial-1.-Pandemia-COVID-19-i-jej-wplyw-na-miedzynarodowa-logistyke.pdf, (access: 4.03.2026 r.).

¹¹ Nyka, M., (2023), *Contemporary Challenges of the Marine Environmental Economy*. Gdańsk Law Studies, 4(61), pp. 178-195.

¹² Rheinheimer, G., (1998), *Pollution of the Baltic Sea*. Naturwissenschaften, 85(7), pp. 318-329.

¹³ Beldowski, J., Beldowska, M., (2023), *The Problem of Metal Pollution in the Baltic Sea*. ACADEMIA. Magazine of the Polish Academy of Sciences, pp. 4-7.

However, it is impossible to eliminate pollution of the sea basin in maritime transport¹⁴. In the case of passenger ships, this will be related to the number of voyages and the size of the vessels carrying passengers, even over short distances. Therefore, passenger ships are often considered the main source of sewage in the sea¹⁵. In 2014, the average capacity of a passenger ship sailing the Baltic Sea was approximately 1,900 people, making the issue of sewage discharge into the sea a key ecological threat. Sewage discharged from ships is a source of nutrients that further contribute to eutrophication¹⁶.

Another pollution problem in the Baltic Sea is oil spills¹⁷, mainly when refueling and in the event of collisions of vessels on the open sea¹⁸. This is due to the ever-increasing number of ships in a relatively small area, but also to small passages where vessel traffic accumulates. An example is the Danish Straits, where all ships entering or leaving the region, regardless of whether they are sailing to or from ports in the northern or southern Baltic, must pass through this area. Another example is the Kiel Canal, which shortens the travel time from the Baltic to the North Sea and vice versa, as well as the Motorway of the Sea near Bornholm and Gotland, where traffic in both directions is very heavy. And due to the sanctions imposed on Russia by the European Union, traffic has become even heavier. This situation actually forces the number of accidents, which increase annually, with estimates indicating that on average, over 110 dangerous incidents occur there, including accompanying oil spills in the Baltic Sea¹⁹. This is confirmed by data obtained from the HELCOM network, which constantly monitors all accidents thanks to the AIS (Automatic Identification System) indications (Figure 2.).

¹⁴ Hassler, B., (2016), *Oil Spills from Shipping: A Case Study in Managing Accidental Hazards and Intentional Pollution in the Baltic Sea*, [in:] *Environmental Governance of the Baltic Sea*, Springer International Publishing, pp. 125-146.

¹⁵ Lehmann, A., Hinrichsen, H. H., Getzlaff, K., (2014), *Identification of potentially high-risk environmental pollutants in the Baltic Sea*. Boreal environmental studies, 19(2), pp. 140-152.

¹⁶ Mikołajczyk, S., Warenik-Bany, M., Pajurek, M., (2023), *Dioxins, furans, and PCBs in imported marine fish – consumer exposure*. Food, Science, Technology, Quality, 30(2), pp. 96-108.

¹⁷ Hassler, B., (2016), *Oil Spills from Shipping: A Case Study in Managing Accidental Hazards and Intentional Pollution in the Baltic Sea*, [in:] *Environmental Governance of the Baltic Sea*, Springer International Publishing, pp. 125-146.

¹⁸ Hassler, B., (2011), *Accidental versus operational oil spills from shipping in the Baltic Sea: risk management and management strategies*, Ambio, 40(2), pp. 170-178.

¹⁹ Bogalecka, M. (2013), *Analysis of the correlation between the number of accidents and the number of ships in the Baltic Sea region*, Maritime Safety Yearbook, 7, 205-213.

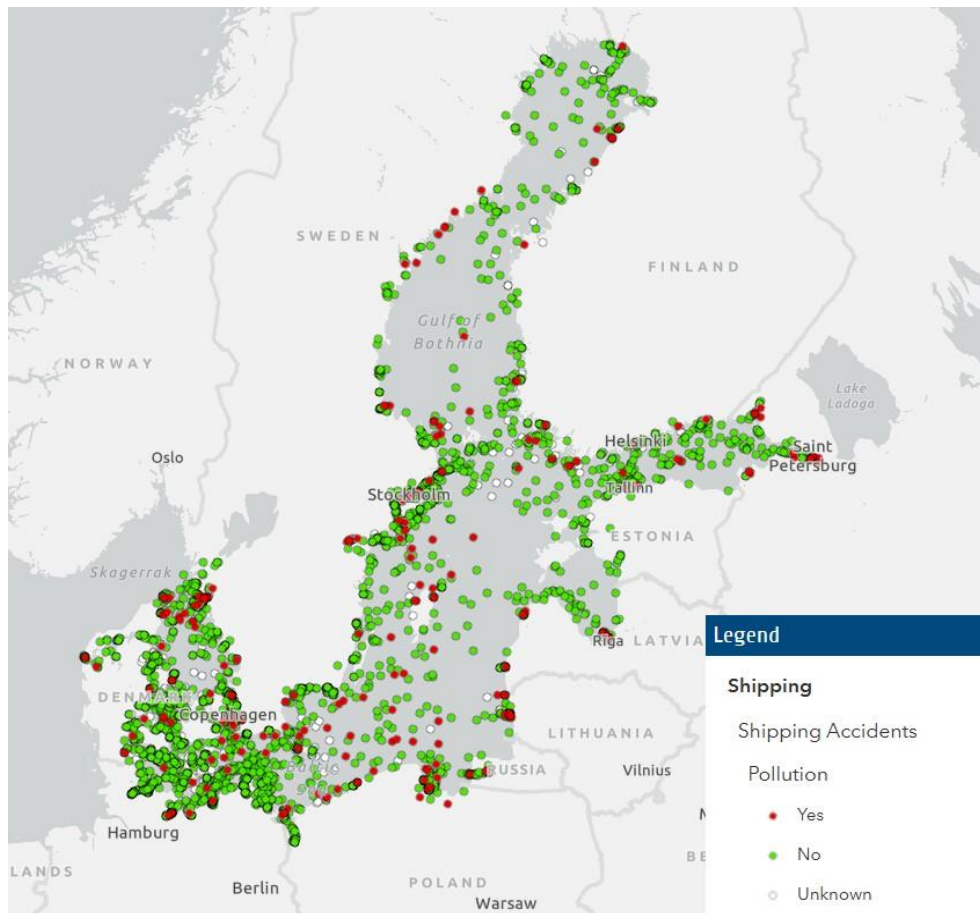


Figure 2. Accidents in the Baltic Sea

Source: maps.helcom.fi/website/mapservice/?datasetID=cae61cf8-0b3a-449a-aeaf-1df752dd3d80 (access: 3.03.2026 r.).

Maritime accidents, however, are not the main cause of pollution, as considering the specific nature of the Baltic Sea, oil and chemical spills can be observed not only in the open sea. Pollution occurring around ports and harbors, where vessels run aground due to human error or vessel breakdown, is also quite troublesome²⁰. The distribution and size of leaks, even the smallest ones, indicate that the problem affects the entire Baltic Sea (Figure 3.).

²⁰ Strepel, R., (2025), *HELCOM's role in promoting sustainable and safe shipping and maritime safety in the Baltic Sea region*. Discover Sustainability, 6(1), 761.

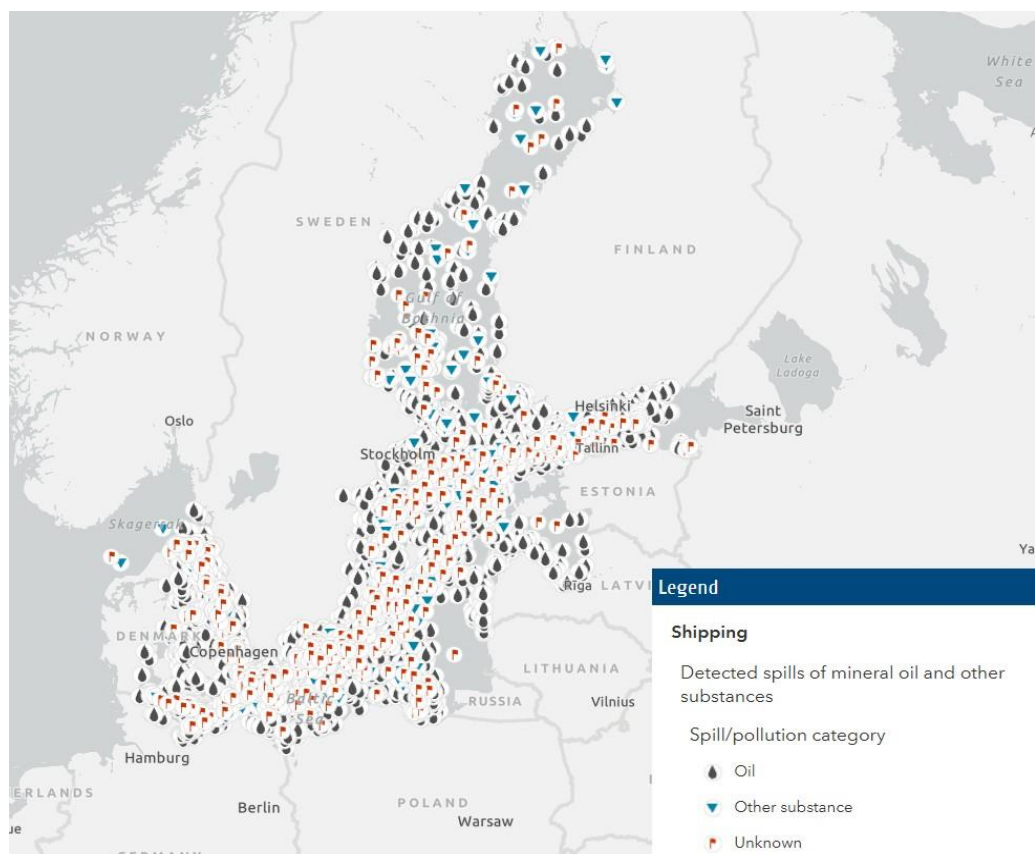


Figure 3. Location and size of leaks observed during aerial surveillance flights by HELCOM contracting parties

Source: maps.helcom.fi/website/mapservice/?datasetID=345c9b95-6e9c-44a4-b02a-ee4304cccffc (access: 3.03.2026 r.).

However, given the magnitude of the risks associated with spills, in an era of globalization crisis triggered by various armed conflicts, one of the most serious pollution problems in the Baltic Sea today is the activity of the so-called „shadow fleet” which is a group of ships, primarily technologically outdated tankers, used by countries subject to international sanctions to circumvent restrictions imposed on their economic sectors. Such ships primarily transport crude oil and other fuels, as well as strategic raw materials in high demand in other parts of the world²¹.

The activities of the "shadow fleet" pose a significant threat to international maritime security²², including threats to the Baltic Sea, for example, from the perspective of initiating a potential ecological disaster. This could happen because "shadow fleet" vessels typically do not undergo regular technical inspections, which increases the risk of failure and, consequently, an oil spill²³. Moreover, due to their use for the transport of strategic raw materials, they can be used as a tool for destructive activities against critical infrastructure in the Baltic Sea (Table 1.).

Table 1. Incidents involving the use of the „shadow fleet” in the Baltic Sea in 2023-2025

Date	Description of the incident
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²¹ Reškiewicz, P. (2025), *Shadow Fleet – a new front for hybrid operations on NATO's eastern flank*. National Security, 46(1), 199-217, doi.org/10.59800/bn/207648 (access: 3.03.2026 r.).

²² Hilgenstock, B., Hrybanowskii, O., Kravtsev, A., (2024), *Assessment of the Russian Shadow Fleet: Initial Expansion, Links to the Global Shadow Fleet, and Future Prospects*, KSE Institute, www.kse.ua/osc/kole/wiadomości/assessing-russia-s-shadow-fleet-initial-build-up-links-to-global-shadow-fleet-and-future-prospects (access: 4.03.2026 r.).

²³ Parlov, I., Sverdrup, U., (2024), *The Emerging „Shadow Fleet” as a Challenge to Maritime Security and Ocean Management*, [in:] *Maritime Security Law in Hybrid Warfare*, Brill Nijhoff, pp. 225-262.

October 2023	Damage to the Balticconnector gas pipeline and submarine power cable
October 2023	Damage to telecommunications cable (Sweden-Estonia)
March 2024	Collision of a tanker with an unidentified vessel in Danish waters (near Jutland)
September 2024	A ship carrying ammonium nitrate gets stuck in Norwegian waters.
November 2024	Damage to the C-Lion1 submarine telecommunications cable (Finland-Germany)
November 2024	Damage to telecommunications cable (Lithuania-Sweden)
December 2024	Damage to the Estlink 2 power cable (Estonia-Finland)
December 2024	Damage to four telecommunications cables between Finland, Estonia and Sweden
January 2025	Damage to a telecommunications cable (Latvia-Sweden) near Gotland
March 2025	A container ship collided with the MV Stena Immaculate tanker, which was carrying jet fuel

Source: Reškiewicz, P. (2025), *Shadow Fleet – a new front for hybrid operations on NATO's eastern flank*. *National Security*, 46(1), 199-217, doi.org/10.59800/bn/207648 (access: 3.03.2026 r.)

Analyzing the above-mentioned incidents in the Baltic Sea, it should be noted that in no case has it been 100% certain that the vessels involved in the maritime incidents belonged to the Russian Federation. The very existence of such a probability is based on the assumptions of organizations and maritime experts.

For example, according to the Norwegian Coast Guard, some of the oil leaving Russian Baltic ports is reloaded onto larger vessels, for example, off the coasts of Morocco, Spain, and Greece, and then directed to Asia. Furthermore, there has been a noticeable increase in the frequency of oil shipments in the Baltic Sea. Another example is the argument of Atlantic Council experts, who point out that all incidents in the Baltic Sea are related to the emergence of a Russian „shadow fleet” composed primarily of aging ships that sail without required insurance and are not regularly maintained. Their ownership is opaque, they frequently change names and registrations, and they operate in violation of maritime law. Windward, a company using AI tools to manage risks in the seas and oceans, has made a different observation: „shadow fleet” tankers often conceal their location by, for example, disabling the vessel's positioning systems. According to the Centre for Research on Energy and Clean Air (CREA), nearly half of all „shadow fleet” tankers carrying Russian crude oil are registered in the United Arab Emirates or Russia. However, as the company itself states, there is no evidence that these activities are coordinated by the Russian authorities, because, as experts point out, Russian „shadow fleet” vessels are operated by many individual companies or intermediaries, not a single operator²⁴.

Despite the lack of evidence, in the context of improving the safety of the Baltic Sea, a statement was made at the 1546th meeting of the Committee of Ministers' Deputies of the Council of Europe on 10 December 2025 about the environmental threats caused by the „shadow fleet” in the Baltic Sea.

The statement suggests that the Baltic Sea is emerging as a new area of ecological confrontation, requiring continued vigilance and increased investment in regional resilience, including enhanced protection of critical infrastructure. A rapidly growing and unprecedented threat in the Baltic Sea comes from a „shadow fleet” used by Russia, which, in order to circumvent sanctions, evade safety or environmental regulations, avoid insurance costs, or engage in other illegal activities, operates vessels to further finance its aggression against Ukraine, but also poses a serious threat to maritime security, the marine environment, and regional security, extending beyond the Baltic Sea²⁵.

Research materials and methods

²⁴ www.ies.lublin.pl/komentarze/rosyjska-flota-cieni-na-morzu-baltyckim/ (access: 4.03.2026 r.).

²⁵ www.gov.pl/web/re/oswiadczenie-o-zagrozeniach-srodowiskowych-spowodowanych-flota-cieni-na-baltyku (access: 4.03.2026 r.).

Analyzing the above, particularly the existence of ecological threats and the public concern over the ongoing pollution of the Baltic Sea, it was deemed appropriate to highlight this aspect, as it is quite important from the perspective of maintaining the purity of this important sea body.

The main goal of the conducted research is to demonstrate the impact of „shadow fleet” vessels, as a destructive element of the ecological order in the Baltic Sea, on the potential for changes in the ecological structure of marine areas and adjacent areas, distinguished by their unprecedented pristine nature and cleanliness, which is often included as a priority in the functioning of the Baltic Sea state. This study is definitely not intended to demonstrate an element of ecological panic, due to the presented simulation model. However, given the fact that economic sanctions against the aggressor state – Russia – regarding Ukraine are still in place, it can be assumed that uncontrolled vessel traffic could increase the real threat of marine contamination, which in turn could affect the growing threat to the population living in the coastal areas of the Baltic Sea.

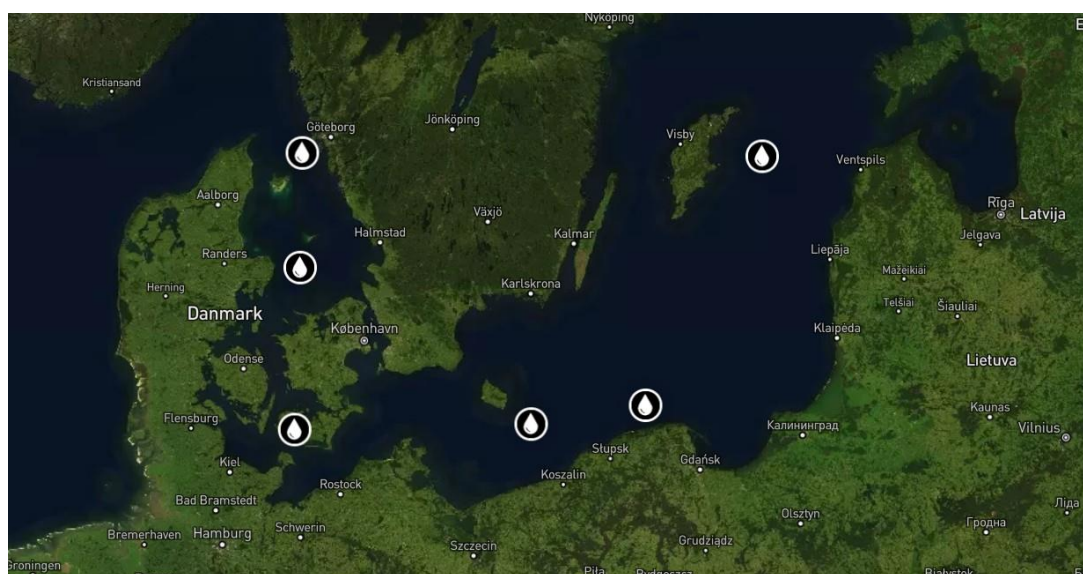
With this in mind, and the significant gap inherent in the topic's complexity, this study attempts to present a different perspective: a simulation of the existing ecological threat in the South Baltic zone. Therefore, the main goal of this study is to demonstrate the impact of the "shadow fleet" on ecological threats in the South Baltic zone, based on publicly available simulation models, which provide a basis for taking action to counteract any potential crisis incidents.

The following research methods and tools were used in the study:

- Secondary analysis of literature sources and legislative data in Poland and the European Union – this method allowed us to analyze available data on the impact of the „shadow fleet” on the initiation of ecological threats in the Baltic Sea area.
- Case study method – this approach allowed us to analyze available simulation models in the context of the impact of the "shadow fleet" activity in the Baltic Sea on the initiation of possible changes in the context of area contamination caused by oil and petroleum spills.

The impact of the "shadow fleet" activity on the ecological threat to the Baltic Sea – simulation

Taking into account the above thesis, which focuses on the fact that there is no evidence of sabotage by the Russian Federation in initiating threats in the Baltic Sea, based on available expert information, it can be assumed that the incidents in the Baltic Sea are related to the activities of the so-called „shadow fleet” and it is worth considering variants of its greater activity. Therefore, with the above in mind, eight simulations of oil spills from tankers operating in the Baltic Sea were created at the request of Greenpeace²⁶. A hypothetical simulation was created for selected locations on the routes with the highest traffic intensity (Figure 4.).



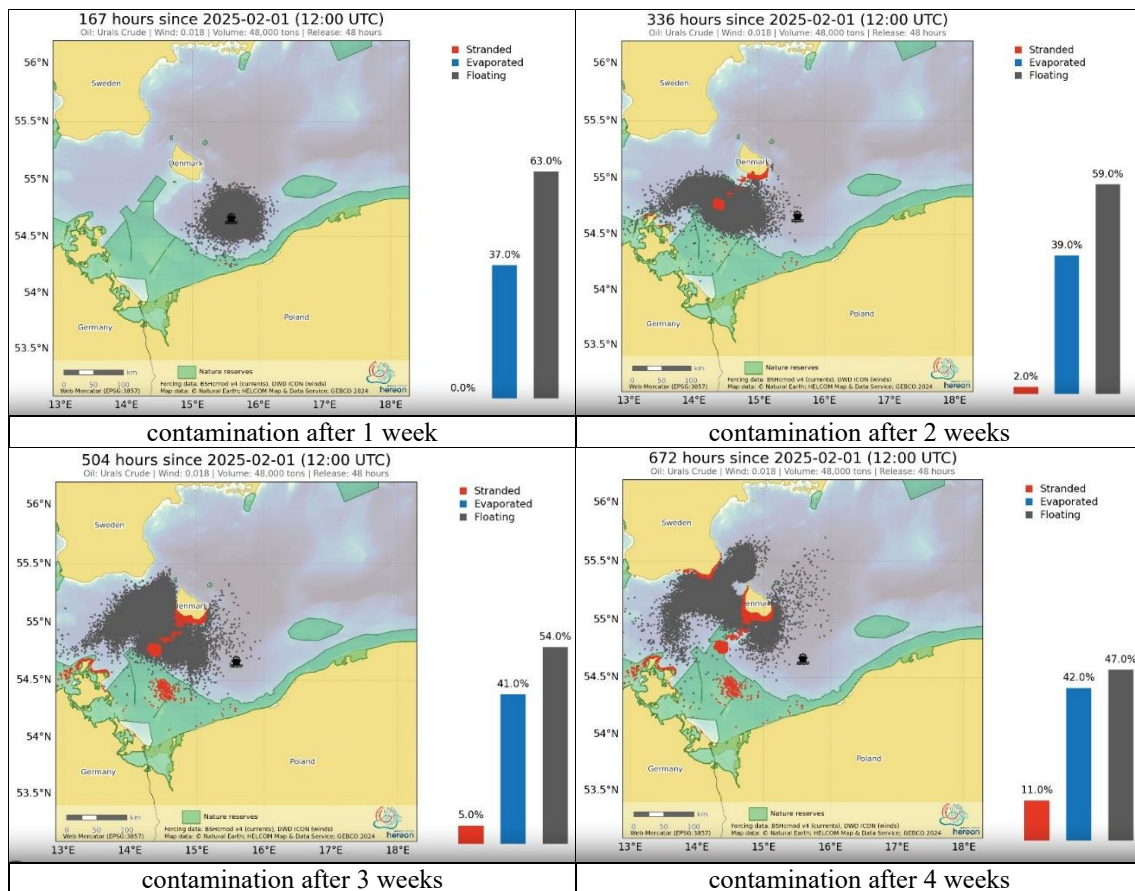
²⁶ www.maps.greenpeace.org/maps/gpde/shadowfleet-spills/ (access: 4.03.2026 r.).

Figure 4. Oil spill simulation areas in the Baltic Sea

Source: <https://act.gp/flotacienia>

The above simulations were developed by the leading German research center Helmholtz Hereon for a tanker carrying 48,000 tons of oil, based on data on sea currents and winds in winter, provided by the German Federal Maritime and Hydrographic Agency²⁷. The study uses available simulation material divided into four periods – weeks, which are indicators of pollution related to the oil spill in selected areas of the South Baltic Sea.

Considering oil pollution simulations around the Danish island of Bornholm and the region between Ystad and Trelleborg in southern Sweden, it should be noted that areas with exceptionally clean landscapes, combining the sandy coast of the Baltic Sea with picturesque forests and protected areas, may be subject to degradation. The areas of Bornholm and Sweden are areas of increased tourist activity. Bornholm itself is considered a gem, offering a wide range of attractions, including scenic cycling routes, ideal for active recreation, and fascinating historical sites such as Hammershus (Figure 5).



²⁷ www.greenpeace.org/poland/aktualnosci/39405/statki-rosyjskiej-floty-cieni-to-tykajace-bomby-ekologiczne-mamy-nowe-symulacje-wyciekow-na-baltyku/ (access: 4.03.2026 r.).

Figure 5. Simulation of an oil spill near Bornholm Island

Source: prepared based on <https://act.gp/flotacienia>

As a result of the oil spill in this area, the following areas will also be contaminated: Ystads Sandskog, a nature reserve consisting of a 4-kilometer stretch of protective pine forest between the eastern part of Ystad and the mouth of the Nybroån River; and the Mossbystrand coast, a nature reserve located between Ystad and Abbekås, famous for its clean, sandy beaches and dunes. Fyledalen, a nature reserve that is one of the cleanest and most biologically diverse areas in the region, famous for its rich fauna, including golden eagles, and its canyon-like terrain, may also be affected.

Analyzing the simulation of Baltic Sea contamination in the Central Baltic region, contamination near Bornholm will also impact environmental degradation around the central part of the Polish coast. As a result of marine contamination, for example, due to the breakdown of a tanker from the shadow fleet, a very attractive area, both in terms of nature and tourism, on the Central Coast of Poland may be degraded. This area is characterized by low maritime activity. Although it has three seaports: Kołobrzeg, Darłowo, and Ustka, there is negligible vessel traffic, making it a very tourist-friendly area (Figure 6.).

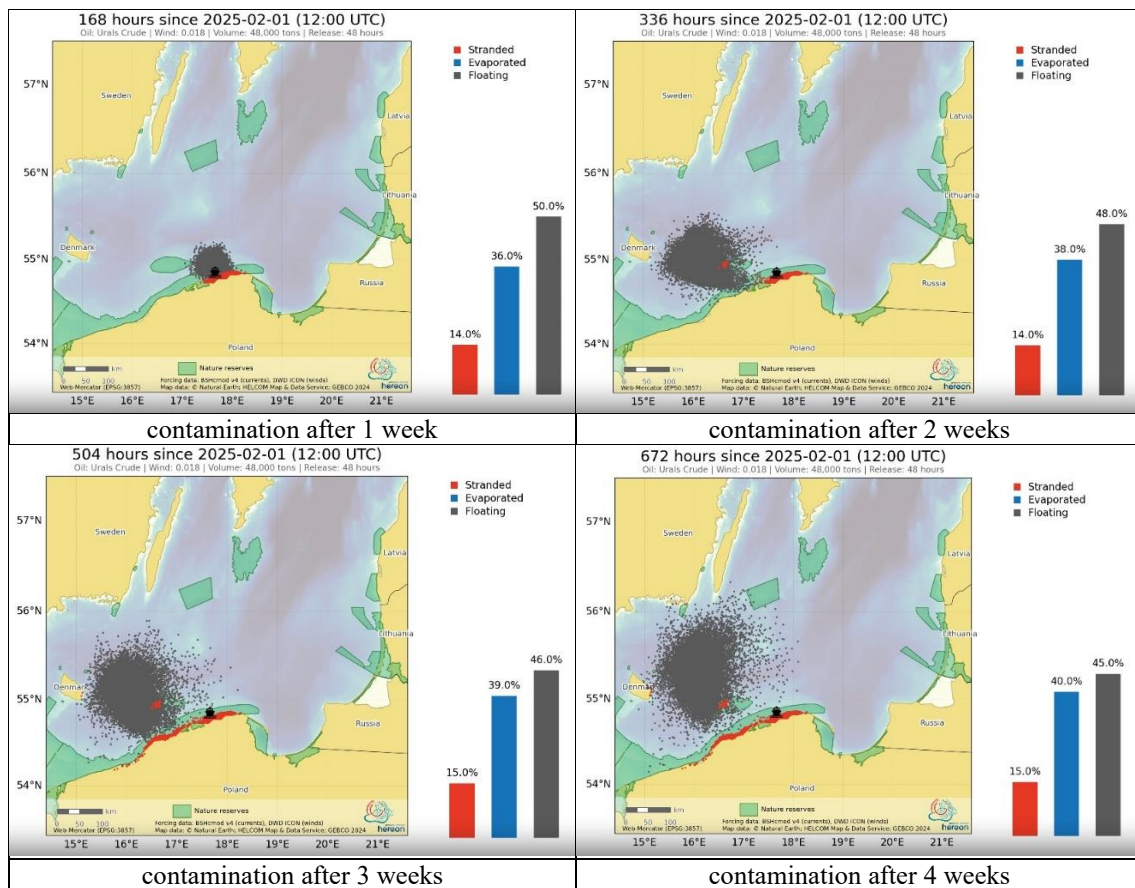


Figure 6. Simulation of an oil spill on the Central Coast of Poland

Source: prepared based on <https://act.gp/flotacienia>

The indicated area, with its small seaports and marinas, serves as a base for tourism and sea fishing development, rather than as a component of a larger shipbuilding industry. Therefore, the development of the tourism product in this area is a determinant of development not only in economic terms but also in ecological and environmental terms, stemming from the fact that within the region's borders there are two coastal national parks, five landscape parks, and dozens of nature reserves.

Therefore, the simulated contamination would primarily trigger an ecological disaster for the entire Koszalin Coast, which borders the Trzebiatów Coast and the Gryfice Plain to the west, and the Kępa Swarzevska and Kępa Pucka to the east. The losses will certainly affect an area of nearly 7000 hectares. km², which is divided into six mesoregions: the Łeba and Reda proglacial valley, the Białogard Plain, the Sławińska Plain, the Słowińskie Coast, the Damnica Upland and the Żarnowiecka Upland.

Based on the analysis of Baltic Sea contamination simulations, it can be concluded that a significant portion of the Słowińskie Coast, located in the southern Baltic coastal belt, will also be vulnerable to environmental degradation. The area stretching from the mouth of the Parsęta River to Kępa Swarzevska will be contaminated, including the relatively shallow coastal lakes of Lake Jamno, Lake Gardno, and Lake Łebsko, which were once bays. Furthermore, the Słowińskie Coast is crisscrossed by numerous short, water-rich rivers that flow into the Baltic Sea or coastal lakes from the moraine hills of the Drawsko Lake District and the Kashubian Lake District. These include, in particular, the Parsęta, Wieprz, Słupia, Łupawa, and Łeba rivers. The largest coastal lakes, Łebsko and Gardno, will likely be contaminated, further impacting the quality of the soil and wet marshes in this area. Analyzing potential contamination sites in the Baltic Sea simulated by the Helmholtz Hereon center, it is worth pointing out that a potential spill near the coast of Lithuania could have a significant impact in this region. It is caused by the isthmus, where there is a relatively high level of ship traffic, which will undoubtedly affect the spread of oil slicks, mainly towards the coast of the largest island in the Baltic Sea-Gotland (Figure 3.).

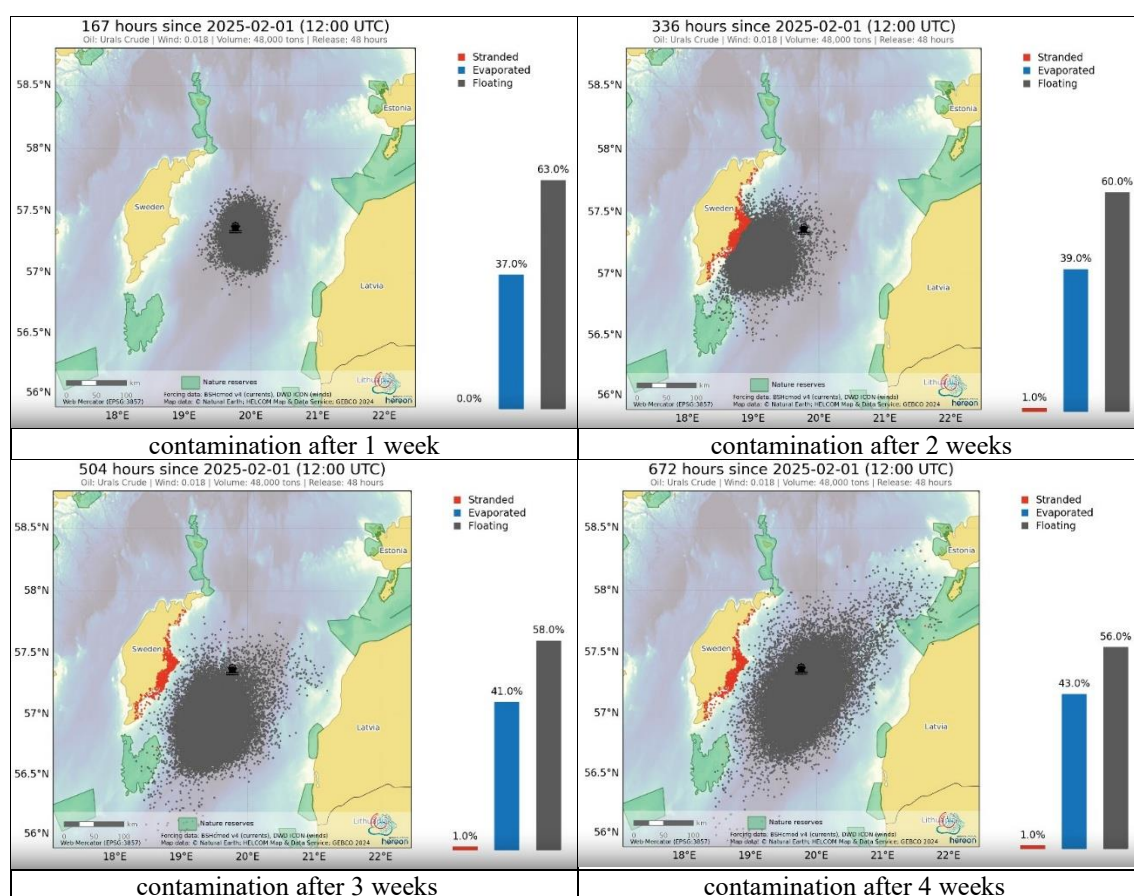


Figure 3. Simulation of an oil spill near Bornholm Island

Source: prepared based on <https://act.gp/flotacienia>

The island itself is one of the most beautiful in the Baltic Sea, often called the „Island of the Gods” due to its extraordinary history connected to the Vikings, the medieval city of Visby, magical beaches, and unique rock formations. A potential oil spill in this area will alter the structure of Gotland's most important natural attractions, such as the raukars, unique limestone inselbergs. They have been carved by water and wind over millions of years. These magical rocks, resembling gigantic figures, can be found in various parts of the island, particularly on Fårö Island and in the Folhammar Nature Reserve. This uniqueness will therefore diminish the value of this area, which is listed as a UNESCO World Heritage Site.

Discussion and Conclusions

The analysis presented raises serious concerns about the increasing dangerous and illegal shipping practices employed by some operators. The identified potential leak locations could undoubtedly impact the waters of the Baltic Sea, as well as coastal areas associated with tourism, where maintaining a pristine environment and minimizing large-scale industry is preferred.

The simulation activity of the „shadow fleet” also poses a significant threat to critical infrastructure, which in the South Baltic zone is associated with the implementation of wind energy and the future operation of the nuclear power plant in Choczewo. While investments are still in progress, work in the Baltic Sea investment zone is still ongoing, resulting in increased vessel density. This situation is causing temporary closures of fishing waters, leading to a certain degree of congestion in the navigation channels between the Gulf of Finland and the Danish Straits, where very heavy pollution is already evident²⁸.

Given these forecasts, the key conclusion is to maintain continuous operational readiness and the ability to respond to threats to our maritime environment, as well as to deploy a support package for naval units from each Baltic state, within their respective competences. Looking at the issue professionally, it's worth noting that the war in Ukraine and the ongoing sanctions imposed on the Russian Federation have exposed the problem of uncontrolled vessels, which impact international maritime security. This increased scrutiny has exposed the fundamental weaknesses and limitations of the current system of flag state jurisdiction and control²⁹.

Flag state jurisdiction itself is the primary mechanism for exercising legal authority on the high seas. However, it must be acknowledged that if a given state is unable or unwilling to fulfill these obligations, other states have limited legal means to intervene, which undermines the legitimacy of the flag state's exclusive jurisdiction.

This situation means that the activities of not only the Russian „shadow fleet” but also any other fleet in the so-called „gray zone” demonstrate shortcomings in the responsibility, jurisdiction, and control of the flag state under international maritime law. Therefore, the problem is the maritime regulatory system, which should be adapted to new challenges, including maintaining ecological safety. Otherwise, the ecological threat to any water body will increase, and legal loopholes will fuel the development of bad maritime practices that, in the eyes of even an aggressor state, are permissible.

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²⁸ www.maps.helcom.fi/website/mapservice/?datasetID=345c9b95-6e9c-44a4-b02a-ee4304ccccff (access: 4.03.2026 r.).

²⁹ www.lup.lub.lu.se/luur/download?func=downloadFile&recordOid=9216746&fileOid=9219037 (access: 4.03.2026 r.).

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