THE STRATEGIC COLLAPSE OF THE RUSSIAN NAVY

IN THE CONTEXT OF THE WAR IN UKRAINE (2022–2025)

MARITIME SECURITY FORUM STUDY

APRIL 2025

Russia's strategic naval collapse in the context of the war in Ukraine (2022-2025)

"A nation that cannot defend its coasts is not a safe nation."

Franklin D. Roosevelt - former US President

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Abstract

The present study provides a structured and comprehensive analysis of one of the most unexpected and strategically significant phenomena of the Russian-Ukrainian war (2022-2025): the progressive collapse of the naval capabilities of the Russian Federation. Through a chronological and thematic approach, the research examines the operational losses suffered by the Russian Navy, especially in the Black Sea theatre, emphasising the profound implications of these losses for contemporary naval doctrines and regional security balances. Moving beyond the simple inventory of destroyed or neutralised military assets, the study explores the technological, tactical, and strategic mechanisms that led to the erosion of Russian maritime supremacy. Special attention is given to the impact of asymmetric warfare, the extensive use of unmanned systems, and the strategic innovation demonstrated by Ukraine. This research contributes to the literature on modern warfare by highlighting the transformation of maritime conflicts in the 21st century and the growing vulnerability of conventional naval forces when confronted with flexible, low-cost and adaptive strategies. The study's conclusions invite a rethinking of the role of naval power in future conflicts, while offering analytical tools for the academic and strategic community concerned with security studies.

Keywords: Russian Navy; Black Sea; Naval Losses; Maritime Security; Asymmetric Warfare; Unmanned Systems; Ukraine Conflict

JEL Classification: F52 ,H56, N47

ARGUMENT

The analysis of contemporary conflicts, especially in their naval dimension, remains insufficiently covered in recent strategic literature, despite the marked developments in the instruments and technologies of sea combat. Our century, marked by the chameleon-like features of hybrid warfare and the intersection of the grey areas of confrontation with new combat technologies, has revealed a dynamic of naval conflicts that can no longer be understood solely in conventional terms of numerical or technological superiority.

Our study aims to provide those interested with an in-depth strategic analysis of one of the least anticipated and at the same time spectacular phenomena of the Russian-Ukrainian conflict: the accelerated degradation of the myth of the Russian Federation's naval capabilities, especially in the Black Sea, as a result of Ukraine's technological, tactical and informational adaptation.

Between 2022 and 2025, the war between Russia and Ukraine produced important transformations not only on land and in the air, but also in maritime space, demonstrating that traditional naval supremacy can be rapidly eroded by asymmetric, creative and relatively low-cost means. The Russian fleet, perceived for decades as an essential instrument of force projection in the Black Sea, became, in the course of the conflict, a vivid example of the vulnerability of conventional large structures to new types of warfare.

In what follows we have analysed in stages, the key moments, losses, adaptations and lessons resulting from this process of strategic naval collapse. Careful documentation, the use of international sources, the integration of quantitative data and comparative tables provide the reader with an x-ray of a military phenomenon unprecedented in recent history, together with an invitation to reflection on the future of naval doctrines, military technology and regional balances.

In this endeavour, we have embarked on an increasingly necessary line of research, namely the critical and analytical assessment of how traditional naval structures can become vulnerable to adaptive, asymmetric, creative strategies. In particular, the degradation of the Russian military fleet in the Ukraine conflict provides a case study of remarkable strategic value in terms of the magnitude and spectacular nature of the losses and, more importantly, the mechanisms and root causes that led to this seemingly implausible naval collapse in the context of the earlier perception of Russian maritime power.

The importance of this study does not derive solely from its descriptive or quantitative value, but from its commitment to understanding the naval phenomenon as an integral part of the profound transformations affecting military art and science in our age. The disappearance of certain ships, submarines or maritime infrastructures must be analysed both as a simple statistical reality and as a symptom of a crisis of adaptability, doctrinal rigidity and, often, an underestimation of the creative capacity of the adversary.

From this perspective, this paper opens a space for problematising how naval supremacy can become, in a relatively short period of time, a strategic vulnerability. The traditional tools of maritime force projection are today confronted with problems that come not only from the conventional military area, but also from the sphere of low-cost technologies, autonomous drones, precision munitions, dispersion and infiltration tactics. Alongside all this, the proposed analysis demonstrates how the maritime domain, once perceived as an

environment of slow and predictable operations, is rapidly transforming into a theatre of operations characterised by speed, flexibility, information volatility and structural vulnerability. Russia's naval losses in the war in Ukraine are thus not only a result of the actual fighting, but also a consequence of the unsuitability of a certain type of military thinking to the realities of modern warfare.

The relevance of this study for international research and for the security community is amplified by the fact that understanding the mechanisms of naval collapse is crucial for anticipating and preventing similar developments in other regional or global contexts. Modern fleets, however well-equipped in technical terms, are nonetheless taking into account the lessons learnt from this conflict. Researchers, strategists, security analysts and decision-makers need to rethink their grids for interpreting the naval and maritime-strategic reality.

In the end, this paper remains, of course, an exercise in applied research, but it also aspires to be a discreet invitation to a continuous re-examination of established models in military analysis. The realities of the present - often more complex and unpredictable than the established models - make it increasingly clear that a different interpretative framework is needed, through intellectual flexibility, methodological openness and the affirmation of technological, psychological and informational dimensions in the study of military phenomena.

Russia's strategic naval collapse as a highly topical issue is perhaps the clearest warning of the beginning of the 21st century of the dangers of rigidity, of overestimating one's own strength and underestimating the innovative potential of the adversary. This paper does not propose simple formulas, but provides tools for understanding, analysing and reflecting - all the more necessary in a strategic order marked by uncertainty, ruptures and profound redefinitions.

The sources for this study are varied:

- Ukrainian media reports and official Ukrainian announcements documenting Russian losses (e.g. Oryx visually confirmed over 17 Russian ships destroyed/damaged[1] , including *Moskva*).
- Analyses by military experts (War on the Rocks[2] , Wilson Centre[3] etc.) which contextualised the events.

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[1] Browne, Gareth. "Every Russian Black Sea Ship Sunk or Disabled by Ukraine: Full List." *Newsweek*, 26 March 2024. Accessed 5 April 2025. https://www.newsweek.com/every-russian-black-sea-ship-sunk-damaged-ukraine-full-list-1884448. https://www.newsweek.com/every-russian-black-sea-ship-sunk-damaged-ukraine-full-list-1884448.

[2] Armstrong, B.J. "The Russo-Ukrainian War at Sea: Retrospect and Prospect." *War on the Rocks*, 21 April 2022. Accessed 5 April 2025. https://warontherocks.com/2022/04/the-russo-ukrainian-war-at-sea-retrospect-and-prospect/. https://warontherocks.com/2022/04/the-russo-ukrainian-war-at-sea-retrospect-and-prospect/.

[3] Kornegay, Patrick Jr, and Hayden Toftner. "Lessons from Ukraine in the Black Sea." *Wilson Center*, 2 October 2024. Accessed 5 April 2025. https://www.wilsoncenter.org/article/lessons-ukraine-black-sea. https://www.wilsoncenter.org/article/lessons-ukraine-black-sea.

- Communications from the UK Ministry of Defence and NATO officials, which provided quantitative (20% of the fleet destroyed in 4 months[4] and qualitative assessments of the impact.
- Investigative media reports (Mediazona, Meduza) and OSINT sources for details of casualties and condition of ships.
- Comments by former officers (such as Admiral Pascal Ausseur)[5] providing doctrinal perspective.
- Historical databases (list of naval losses on Wikipedia[6] or compiled by Oryx) to quantify material losses.
    - These sources confirm the facts and support our conclusions:
- The Russian fleet has lost at least 11 large ships (including a cruiser, a submarine, several destroyers and corvettes), plus numerous smaller ones.
- Russia has indirectly recognised the problems, moving the fleet and publicly admitted through proxy sources the humiliating losses (AFP via Agerpres wrote about "heavy military losses in the Black Sea"[7]).
- Ukrainian drones and Western missiles were decisive factors, forcing Russia to *"move* its *ships ... away from Sevastopol"* to protect them[8] and allowing Ukraine to *"force an end to the blockade"*.

Authors

Bucharest, April 2025

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[4] Zoria, Yuri. "UK Defence Minister: 20% of Russia's Black Sea Fleet Destroyed Over Past Four Months." *Euromaidan Press*, 27 December 2023. Accessed 5 April 2025. https://euromaidanpress.com/2023/12/27/uk-defense-minister-20-of-russias-black-sea-fleet-destroyed-over-past-four-months/. https://euromaidanpress.com/2023/12/27/uk-defense-minister-20-of-russias-black-sea-fleet-destroyed-over-past-four-months/.

[5] Berger, Chloé, and Cynthia Salloum, eds. *Russia in NATO's South: Expansionist Strategy or Defensive Posture?* NDC Research Paper No 16. Rome: NATO Defence College, January 2021. Accessed 5 April 2025. https://www.ulib.sk/files/english/nato-library/collections/monographs/ndc-research-paper/ndc_rp_16.pdf. https://www.ulib.sk/files/english/nato-library/collections/monographs/ndc-research-paper/ndc_rp_16.pdf.

[6] "List of Ship Losses during the Russo-Ukrainian War." *Wikipedia: The Free Encyclopedia*. Last modified: [date last modified]. Accessed 5 April 2025. https://en.wikipedia.org/wiki/List_of_ship_losses_during_the_Russo-Ukrainian_War. https://en.wikipedia.org/wiki/List_of_ship_losses_during_the_Russo-Ukrainian_War.

[7] Agerpres. "Ukraine: Death toll from overnight Russian attack rises to seven, including journalist." *Agerpres*, 26 February 2025. Accessed 5 April 2025. https://agerpres.ro/politic-extern/2025/02/26/ucraina-bilantul-victimelor-atacurilor-rusiei-din-cursul-noptii-creste-la-sapte-morti-intre-care-o-j--1426031

[8] Wolkov, Nicole, Daniel Mealie, and Kateryna Stepanenko. "Ukrainian Strikes Have Changed Russian Naval Operations in the Black Sea." *Institute for the Study of War*, 16 December 2023. Accessed 5 April 2025. https://www.understandingwar.org/backgrounder/ukrainian-strikes-have-changed-russian-naval-operations-black-sea. https://www.understandingwar.org/backgrounder/ukrainian-strikes-have-changed-russian-naval-operations-black-sea.

Russia's strategic naval collapse (2022-2025) in the context of the war in Ukraine

"Sea power is essential to any nation
that wants to protect its interests and assert its influence."
Alfred Thayer Mahan - American naval theorist

1. Introduction

The war that Russia launched against Ukraine in 2022 was initially seen almost exclusively through the prism of land and air battles. However, the conflict also had an important maritime dimension, often neglected in early accounts. The Russian Navy - considered on paper to be the second most powerful in the world thanks to its fleet of nuclear submarines[9] - concentrated a significant part of its effort in the Black Sea area, aiming to dominate the Ukrainian coastline, blockade harbours and support the land invasion. From the very first days of the conflict, the Russian fleet imposed a naval blockade of Ukraine and threatened amphibious landings near Odessa. But during 2022-2025, this apparent Russian naval superiority eroded dramatically. Ukraine - although left almost without a military fleet after its losses in 2014 - has managed, through means of strategic optimisation and modern weaponry, to bring about the strategic collapse of Russian naval power in the Black Sea.

The aim of this study is to analyse in depth the degradation of Russia's maritime capabilities in the period 2022-2025, highlighting in particular the collapse of the Russian Black Sea Fleet and its implications. We will examine, chronologically and thematically, the naval losses suffered by Russia in each year, the factors that led to them, and the impact on Russia's strategic maritime projection and its economic and logistical security. Particular emphasis will be placed on the role of new Ukrainian technologies and tactics - from precision anti-ship missiles to naval drones - in undermining the Russian fleet. We will also discuss lessons learnt and how these events are influencing Russian naval doctrine and global strategic thinking on war at sea.

Methodologically, the study is based on academic sources, military analyses and reliable media reports, duly cited. Information has been corroborated from Western sources (reports of strategic studies institutes, military intelligence bulletins), official Ukrainian sources, etc., as well as available Russian sources (although the latter tend to minimise or misrepresent losses). The structure of the paper is that of an academic

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[9] **Wikipedia contributors.** "Naval Warfare in the Russian Invasion of Ukraine.". Wikipedia, The Free Encyclopedia. Last modified 25 September 2023. Accessed 6 April 2025. https://en.wikipedia.org/wiki/Naval_warfare_in_the_Russian_invasion_of_Ukraine.:contentReference[oaicite:1]{index=1}

analysis, with chapters devoted to each year (2022, 2023, 2024, 2025 situation respectively), followed by thematic chapters on strategic impact, the role of technology and doctrinal conclusions.

In what follows, we will begin by summarising the initial state of the Russian naval forces and Moscow's naval objectives relative to the starting point of the conflict, in order to understand the magnitude of the subsequent decline. We will then detail, year by year, the progressive loss of maritime supremacy, listing the ships destroyed or damaged (both in the Black Sea Fleet and - to the extent of involvement - in the Northern, Pacific and Baltic fleets). We go on to analyse how these losses have affected Russia's ability to project power at sea and to protect its economic interests (such as export routes through the Black Sea). We will also examine Ukraine's tactical innovations - from coastal missile strikes to unmanned naval vehicle attacks - that have changed the rules of the naval game. Finally, we focus on lessons learnt: what this failed naval campaign means for Russian naval doctrine, and what implications it has more broadly for modern naval warfare.

2. Background and Russia's naval capabilities before 2022

Figure no. 1 Black Sea

At the beginning of 2022, the Russian Navy was still perceived as an advanced force, albeit with certain structural vulnerabilities. Russia had four main fleets - the Northern Fleet (the most powerful, including most strategic nuclear submarines), the Pacific Fleet, the Baltic Fleet and the Black Sea Fleet - plus the Caspian Fleet. Of these, the Black Sea Fleet has occupied a key place in Ukraine-related plans, with its main base in Sevastopol (Crimea) and controlling access to the Sea of Azov. After the annexation of Crimea in 2014, Moscow gradually strengthened this fleet, adding new vessels such as *Admiral Grigorovich-class* cruise missile-carrying frigates and upgraded *Kilo-class* diesel-electric submarines equipped with Kalibr missiles. The Black Sea Fleet also had its flagship flagship - the large missile cruiser *Moskva* - as well as modern missile-carrying corvettes and amphibious landing ships.

Initial strategic objectives (February 2022)

At the outbreak of the invasion on 24 February 2022, Russia used the Black Sea Fleet to gain immediate maritime superiority in the north-western Black Sea. In the early days Russian ships set up a blockade of Ukrainian ports[10] , paralysing Ukraine's maritime exports. At the same time, the Russians strategically occupied the Serpents' Island (45 km off the Romanian coast, controlling the mouth of the Danube) and threatened an amphibious landing in the Odessa area, forcing Ukraine to maintain troops in coastal defences. The importance of *Snakes Island* and the reason for the Russian assault also lay in the "desire to establish a land bridge to Crimea"[11] , reducing the vulnerability of the naval base at Sevastopol.

Figure 2 shows the Island of the Snakes

In parallel, Russia deployed a number of large landing ships from the Northern and Baltic Fleets to the Black Sea (passing through the straits before Turkey closed them) to support possible amphibious operations before the invasion. The Black Sea Fleet was joined by units from the Caspian Fleet, which sailed inland waterways and reached the Black Sea in small artillery ships.

Turkey's position and the Mont Mont Convention reux

February 2022, was the month in which Turkey - a riparian country and custodian of access to the Black Sea under the Montreux Convention (1936) - decided to close the Bosphorus and Dardanelles Straits to all military vessels of the belligerents[12] . Under the convention, Turkey has the right to restrict passage in

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[10] Kornegay, Patrick Jr, and Hayden Toftner. "Lessons from Ukraine in the Black Sea." Wilson Center, 2 October 2024. Accessed 6 April 2025. https://www.wilsoncenter.org/microsite/3/node/123859. https://www.wilsoncenter.org/microsite/3/node/123859.

[11] **Colibășanu, Antonia, Alexander Crowther, Joel Hickman and George Scutaru.** "The Strategic Importance of Snake Island." CEPA, 27 September 2022. Accessed 6 April 2025. https://cepa.org/comprehensive-reports/the-strategic-importance-of-snake-island/. https://cepa.org/comprehensive-reports/the-strategic-importance-of-snake-island/.

[12] **"Naval Warfare in the Russian Invasion of Ukraine."** Wikipedia, last modified 25 September 2023. Accessed 6 April 2025. https://en.wikipedia.org/wiki/Naval_warfare_in_the_Russian_invasion_of_Ukraine. https://en.wikipedia.org/wiki/Naval_warfare_in_the_Russian_invasion_of_Ukraine.

wartime if threatened or to limit conflict. The decision meant that Russia could not bring in naval reinforcements from outside the Black Sea (ships from the Northern, Baltic or Pacific Fleet could no longer enter), nor could the Russian Black Sea Fleet go out to operate in the Mediterranean. The only exception allowed by Montreux was for ships to return to their permanent base, which in practice meant that some Russian ships in the Mediterranean at the start of the war were stuck outside the Black Sea. Overall, Turkey's decision prevented Russia from compensating for possible losses in the Black Sea with ships from other theatres of naval operations.

Initial naval capabilities

At the start of the invasion, the Black Sea Fleet included, among others:

a) *1 Missile Carrier Cruiser,* project 1164 *Slava*, flagship capable of supporting long-range anti-air defence of naval groups.
b) *3 modern frigates, the Project 11356R Admiral Grigorovich - Admiral Makarov*, *Admiral Essen* and *Admiral Grigorovich* (the last possible ???? deployed in the Mediterranean at the time) carrying Kalibr cruise missiles with which Russia often struck land targets deep in Ukraine.
c) *Missile-carrying corvettes and small Buyan-M* (with Kalibr missiles) and *Tarantan/Molnia* (with older anti-ship missiles), plus light anti-submarine patrol vessels.
d) *Diesel-electric submarines (upgraded Kilo-class):* 6 units deployed in Crimea, equipped with Kalibr missiles that can be launched from underwater, making them a formidable asset for Russia's long-range strikes.
e) Large (3 *Ropucha-class* and 1 *Tapir-class*) and medium-sized *amphibious landing ships (Serna-class*), theoretically prepared for landing in force.
f) *Other support vessels including* mine dredgers, tugs, oil tankers, etc.

In the other fleets, Russia also possessed considerable capabilities (e.g. similar *Moskva* cruisers in the Northern and Pacific Fleet, destroyers, the aircraft carrier *Admiral Kuznetsov* - but under prolonged repair, etc.), but these forces could not intervene directly in the Black Sea because of the blockade of the straits. Therefore, the fate of the Russian naval campaign in Ukraine depended almost exclusively on the Black Sea Fleet and the units brought in before the invasion.

Vulnerability assessment

Although imposing on paper, the Russian Black Sea fleet had several vulnerabilities: many ships were of old Soviet design (the cruiser *Moskva* dates from the 1980s, as do the large landing ships), and their air and missile defence systems, while theoretically powerful, had not been tested in a high-intensity conflict. The relatively small area of the Black Sea and the proximity of enemy coasts (Ukraine, but also NATO - Romania, Bulgaria and Turkey) meant that Russian ships were exposed to early detection and attack from shore. A former French admiral remarked: "The Black Sea is a small sea" - the density of surveillance and ground attack means that no ship (Russian or Ukrainian) can operate undetected; any ship detected can be tracked and

targeted. These geographic and technological aspects, dramatically combined, were to prove decisive in the evolution of naval warfare.

Thus, in early 2022 Russia set out with the ambition of a quick naval victory: to dominate the Black Sea, isolate Ukraine from access to the sea, and possibly carry out a strategic breakthrough. The following chapters will show how, contrary to these expectations, the Russian fleet was gradually pushed on the defensive and severely eroded as Ukraine fought back with ingenious and effective means.

Next, we analyse the years 2022, 2023 and 2024 in turn to highlight the progressive degradation of Russian maritime capabilities and the key moments that marked Russia's strategic naval collapse in this conflict.

3. 2022 - From domination to the first naval defeats

Initial Russian offensive and control of the northern Black Sea

In the early weeks of the invasion (February-March 2022), Russia seemed to be achieving its immediate naval objectives. The Russian fleet was patrolling aggressively between Crimea and the Ukrainian coast, imposing a no-go zone for commercial shipping in much of the northern Black Sea[13] . Ukraine's Black Sea ports (Odessa, Mykolaiv, Chornomorsk, etc.) have been blockaded, with dozens of foreign ships trapped. In the early days of the conflict, several neutral merchant ships were hit by missiles or floating mines, illustrating the danger in the conflict zone. One notable incident was on 3 March 2022, when the Panamanian-flagged cargo ship MV *Helt*[14] hit a drifting mine off Odessa and sank after allegedly being forced by the Russians to sail into a mined area. The presence of sea mines - detached from anchors or deliberately placed - became a high-grade risk at the start of the war, with NATO[15] and IMO[16] issuing navigational warnings.

The Russians managed to occupy Snake Island as early as 24 February, capturing the small Ukrainian garrison there (the famous "Russian ship, go...!" incident, when the border guards said to the cruiser *Moskva*). Control of the island has allowed the Russians to extend radar surveillance and ban sailing off Ukraine's southern coast. At the same time, in late February and early March, several Ukrainian patrol vessels, tugs and Coast Guard boats were captured or sunk by Russian forces. Ukraine's much weaker navy even sank its own flagship - the frigate *Hetman Sahaidachnyi*[17] - in Mykolaiv harbour on 3 March to prevent it falling into

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[13] Raul (Pete) Pedrozo. "Russia-Ukraine War at Sea: Naval Blockades, Visit and Search, and Targeting War-Sustaining Objects." *Lieber Institute West Point*, 2023. Accessed 5 April 2025. https://lieber.westpoint.edu/russia-ukraine-war-naval-blockades-visit-search-targeting-war-sustaining-objects/. https://lieber.westpoint.edu/russia-ukraine-war-naval-blockades-visit-search-targeting-war-sustaining-objects/.

[14] *Ibid*.

[15] https://www.marinelog.com/news/nato-warns-of-mine-danger-areas-in-northwest-black-sea/ - accessed 8 April 2025

[16] https://www.imo.org/en/MediaCentre/HotTopics/Pages/MaritimeSecurityandSafetyintheBlackSeaandSeaofAzov.aspx - accessed 8 April 2025

[17] https://www.pravda.com.ua/eng/news/2022/03/4/7328077/ - accessed 8 April 2025

Russian hands. Virtually after the first few days, Ukraine was left without an operational surface fleet and Russia seemed free to dominate the sea.

Russian warships directly supported the land offensive in the south: they launched Kalibr cruise missiles from the sea against targets in Ukraine and carried out coastal bombardments. The Russian fleet also began to bring supplies and reinforcements by sea for the invading troops to the ports conquered by the Russians (Berdiansk, Mariupol, Henicesk on the Azov coast). The prospects of an amphibious landing near Odessa were being taken seriously; a group of Russian troopships (including those brought in from other fleets) swarmed close to the coast, putting pressure on Ukraine to disperse its defences.

As early as March 2022, however, the first signs that Russian naval supremacy would be challenged emerged. Ukraine retaliated by asymmetric means, capitalising on the aforementioned vulnerabilities. Below we will detail the loss of Russian ships in 2022, events that marked the beginning of the strategic decline of the Russian fleet.

First Russian naval losses in 2022

Berdiansk attack (24 March 2022)

An early blow for the Russian Navy came just a month after the invasion. On 24 March, Ukrainian forces attacked the port of Berdiansk (in the south of Zaporizhevsk Oblast, on the Azov Sea coast), where Russian landing ships had docked to unload equipment. Around 7am, loud explosions rocked the docks. The large landing ship *Saratov* (Tapir/Alligator class) was hit and destroyed at the quay[18] , subsequent fires led to the explosion of ammunition on board. Film footage showed *the Saratov* in flames, and two Ropucha-class dropships - *Caesar Kunikov* and *Novocearkassk*, alongside - rushed away, billowing smoke. According to Ukrainian sources, the attack may have been carried out with a Tochka-U ballistic missile or a multiple missile fire, which have not been fully confirmed. What is certain is that the *Saratov* was sunk (the Russians later managed to raise its wreck in 2023, but the ship was a total loss. The other two ships, *Kunikov* and *Novocearkassk*, suffered moderate damage and escaped then. (We will see, however, that both were eventually destroyed by the Ukrainians the following year on their second attempt - *Kunikov* in 2024 and *Novocearkassk* in December 2023. The Berdiansk attack demonstrated the vulnerability of Russian ships when in an advanced harbour, close to the front line, and was a moral boost for Ukraine.

Vasili Bîkov incident (March 2022)

In early March, Ukraine claimed to have sunk the Russian patrol vessel *Vasily Bishkov* (Project 22160), which had taken part in the assault on Snake Island. Video footage showed a ship targeted by coastal artillery

[18] Military Leak. "Ukraine Destroys Russian Alligator-Class Landing Ship Landing Tank Orsk with OTR-21 Tochka Missile." *Military Leak*, 24 March 2022. Accessed 5 April 2025. https://militaryleak.com/2022/03/24/ukraine-destroys-russian-alligator-class-landing-ship-tank-orsk-with-otr-21-tochka-missile/. https://militaryleak.com/2022/03/24/ukraine-destroys-russian-alligator-class-landing-ship-tank-orsk-with-otr-21-tochka-missile/.

or rocket fire south of Odessa. Later, on 16 March, *Vasili Bishkov* appeared in Sevastopol, refuting that claim. The episode highlighted the Ukrainian possibility of hitting even Russian patrol vessels, using camouflage and night strikes.

Diving of the *Moskva* Cruiser (13-14 April 2022)[19]

The defining event of 2022 in naval warfare - and possibly of the entire conflict - was the sinking of the Russian flagship *Moskva*. On the evening of 13 April, while about 100 km off the Ukrainian coast (south of Odessa, east of Snake Island), the *Moskva* was hit by two Ukrainian Neptun land-launched anti-ship missiles. The Ukrainian-produced R-360 Neptun missiles were a newly introduced weapon (derived from the Soviet Kh-35 model, with an extended range of ~300 km) and had never before been used in combat. The strikes caused a catastrophic fire aboard the cruiser, which was also carrying high-calibre anti-ship missiles and anti-aircraft ammunition. Internal explosions paralysed the ship. The crew - made up of more than 500 sailors - sent messages for help. Other nearby Russian ships and rescue services intervened, but on the night of 13/14 April, in rough seas, the *Moskva* capsized and sank.

Figure 3 is the impact image. Non-copyrighted photo

For Russia, the loss of the cruiser *Moskva* was a colossal blow with multiple implications:

a) *The Moskva* was an iconic flagship, the flagship of the Black Sea Fleet and once the pride of the Soviet Navy (it was launched in 1979 as *Slava*). It had a displacement of more than 12,000 tonnes and was Russia's largest and best-armed warship in the Black Sea. Its sinking "destroyed the Russian Navy's sense of invulnerability" and induced reluctance among Moscow strategists to take risks at sea.

b) In tactical terms, the *Moskva* was equipped with long-range anti-aircraft systems (S-300F and Osa-M) which provided an 'umbrella' of air defence for the entire Russian naval group in the area. Until then, other ships relied on the *Moskva* for early warning and protection against enemy aircraft or missiles. Once this ship was lost, the rest of the fleet became much more exposed. One Ukrainian

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[19] Ukrainian News. "Navy Tells How Russia Tried to Save Moskva Cruiser after Ukrainian Strike." *Ukrainian News*, 2 April 2025. Accessed 5 April 2025. https://ukranews.com/en/news/1073858-navy-tells-how-russia-tried-to-save-moskva-cruiser-after-ukrainian-strike.
https://ukranews.com/en/news/1073858-navy-tells-how-russia-tried-to-save-moskva-cruiser-after-ukrainian-strike.

officer claimed that the *Moskva* was "the key to Russian domination of the Black Sea" - a key that the Ukrainians had just thrown on the seabed.

c) Exact human casualties remain controversial. Officially, Russia has admitted only 1 dead and 27 missing, claiming that the rest of the crew had been evacuated. Independent Russian sources (Novaya Gazeta) estimated at least 40 sailors killed, while some Western reports speculated a much higher toll (up to several hundred). The ship's captain, Anton Kuprin (confirmed dead by Ukrainian sources), was among the casualties, and survivors later gave accounts of the chaos on board.

d) Russia's morale and image have suffered a severe shock. *The Moskva* is the largest battleship sunk in combat since 1945. The incident has demonstrated to the world the vulnerability of large ships to modern missiles, especially when these ships are not protected by effective anti-aircraft defences or evasive manoeuvres. The UK's defence chief commented in late 2022: "Russia's dominance in the Black Sea has now been called into question".

From the perspective of the Ukrainian campaign, the sinking of the cruiser *Moskva* was a huge military and psychological achievement. It demonstrated that, using indigenous technology (Neptun missiles) and clever tactics (probably a radar diversion, given that the Russians were taken by surprise), Ukraine could strike at the very heart of the Russian fleet. The operation was also aided by Western intelligence, according to US media sources - NATO satellites and surveillance planes (P-8) tracked *the Moskva's* position, and Ukraine would have received targeting clues (although these details are not officially confirmed in the sources cited, the US is known to have provided Ukraine with intelligence information during the conflict). After the sinking of the *Moskva*, the Russian Navy was forced to "significantly scale down its operations in the face of an adversary with far inferior naval capabilities". The Russians became much more cautious near the Ukrainian coast.

Snake Island campaign and other blows (May-June 2022)

Following the loss of *Moskva*, the Russians continued their incursions into the waters around Odessa for a while, but "in a different pattern, of shorter range and duration, generally around Crimea". Basically, they began to avoid the north-western Black Sea, now considered extremely dangerous. The Ukrainians have stepped up their attacks on the Russian garrison on Snake Island, using Turkish-made Bayraktar TB2 Bayraktar TB2 drones and precision artillery. Russian anti-aircraft defences on the tiny island (*Tor* and *Pantsir* systems brought there) proved insufficient: TB2 drones managed to destroy, in late April and May 2022, several targets on and around the island - including **fast landing craft** (at least one Serna[20] was pulverised by a drone in May, with the images going viral), a **Mi-8 helicopter** full of troops as it landed, and even anti-aircraft vehicles stationed on the island. These strikes have eroded Russia's ability to hold onto Snake Island.

[20] Naval News. "Russian Serna-Class LCU Becomes the New Victim of TB2 Drone." *Naval News*, 7 May 2022. Accessed 5 April 2025. https://www.navalnews.com/naval-news/2022/05/russian-serna-class-lcu-becomes-the-new-victim-of-tb2-drone/.

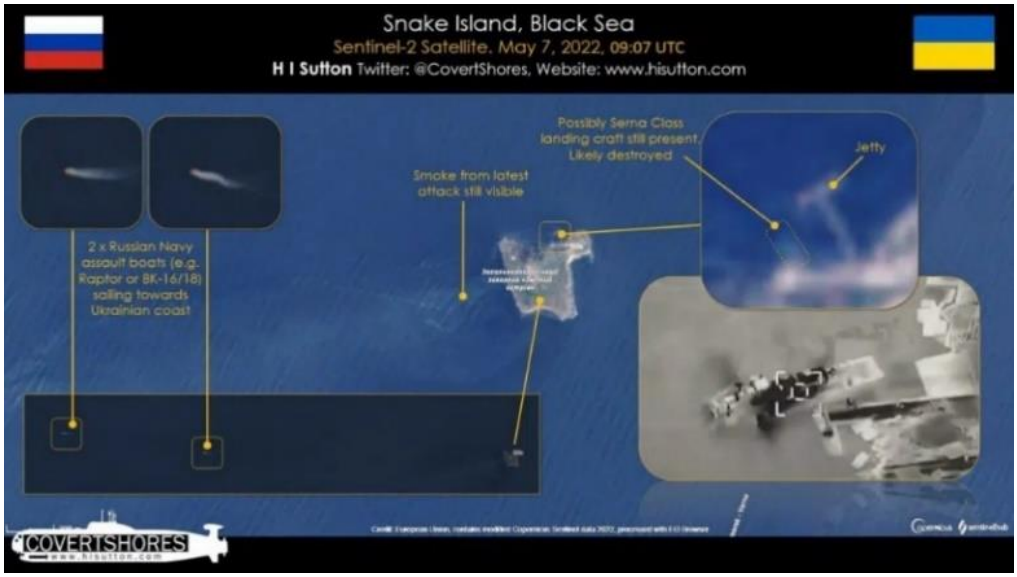

Fig. 4: An infographic showing the wreck of the Serna-class landing craft and the fleeing boats (Source: H I Sutton, used with permission)

One notable blow was the sinking of the rescue tug *Vasili Beh* (SB-739)[21] on 17 June 2022. *Vasili Beh* was carrying personnel and equipment (including an anti-aircraft system on Snake Island when it was targeted by Ukraine. According to Ukrainian sources, the ship was hit by two Western Harpoon anti-ship missiles recently delivered by Denmark. The Harpoons hit the tugboat head-on, sinking it despite the fact that it was supposedly defended by the Tor system on board. The incident showed that once Ukraine received state-of-the-art anti-ship missiles from the allies, even the smaller Russian support ships were not safe.

Fig. no.5: The second anti-ship missile headed towards the Russian tug immediately after the first one caused an explosion (Screenshot from images recorded by TB2 Bayraktar UAV)[22]

[21] Ozberk, Tayfun. "Ukraine Strikes Russia's Vasily Bekh Rescue Tug with Antiship Missiles." *Naval News*, 17 June 2022. Accessed 5 April 2025. https://www.navalnews.com/naval-news/2022/06/ukraine-strikes-russias-vasily-bekh-rescue-tug/. https://www.navalnews.com/naval-news/2022/06/ukraine-strikes-russias-vasily-bekh-rescue-tug/.

[22] Ozberk, Tayfun. "Ukraine Strikes Russia's Vasily Bekh Rescue Tug with Antiship Missiles." *Naval News*, 17 June 2022. Accessed 5 April 2025. https://www.navalnews.com/naval-news/2022/06/ukraine-strikes-russias-vasily-bekh-rescue-tug/. https://www.navalnews.com/naval-news/2022/06/ukraine-strikes-russias-vasily-bekh-rescue-tug/.

Moreover, after the sinking of the tug, Harpoon missiles were also used against Russian-owned offshore oil platforms (the so-called "Boiko towers"[23] off Crimea, equipped with Russian surveillance radars); the strike of those platforms in June 2022 further degraded the Russian device's image of invulnerability.

Fig. No.6 The drilling platforms known as "Boiko Towers"- Photo via X / Nexta

Under these pressures and suffering heavy losses of men and assets in the Snake Island area, Russia decided to withdraw. On 30 June 2022, Russian troops and technology were evacuated from Snake Island and the island returned to Ukrainian control. Moscow claimed it was a "goodwill gesture" to facilitate Ukrainian grain exports, but the widely recognised reality was that maintaining the island had become militarily impossible and was a "victory for Ukrainian drones and missiles". The withdrawal from Snake Island completely eliminated the threat of a Russian landing in Odessa and marked Russia's strategic failure to control the north-western Black Sea.

In summary, the year 2022 began with Russia on the naval offensive, but ended with Russia cautious and partly on the defensive at sea*:*

a) The loss of *Moskva* drastically reduced the Russian fleet's range and aggressiveness.

b) Ukraine, though without significant warships, has compensated with mobile coastal systems and air strikes/drone strikes, turning part of the Black Sea into a "no-go zone" for Russian warships.

c) Russia was forced to accept a diplomatic arrangement for Ukrainian grain exports - the Black Sea Grain Initiative brokered by the UN and Turkey, which came into force on 22 July 2022[24] . This agreement created a secure maritime corridor for merchant ships from three Ukrainian ports, which implicitly meant that Russia could not fully control Black Sea traffic without coming into direct conflict with Turkey and the international community.

d) Russian forces have begun to strengthen the defences of their Crimean ports. After the 2022 maritime drone attack (see next section), Russian submarines were moved from the exposed base at Sevastopol to the more sheltered Novorossiysk harbour in the Caucasus. For fear of further

[23] https://adevarul.ro/stiri-externe/europa/kievul-a-recastigat-turnurile-boiko-din-marea-2299065.html

[24] https://www.romania-actualitati.ro/stiri/in-lume/acordul-privind-exportul-cerealelor-ucrainene-pe-marea-neagra-a-fost-prelungit-cu-2-luni-id177772.html

Ukrainian attacks, some of the Black Sea Fleet's assets have been moved away from the conflict zone, diminishing the fleet's ability to project force.

Towards the end of 2022, it was becoming clear that the "Russian fleet was failing to assert **itself"** in the war against Ukraine, despite its initial superiority. The next chapter will analyse developments in 2023, a year in which Ukraine expanded its use of new technologies (notably naval drones and Western missiles) and administered even greater losses to Russia, putting its fleet in a critical situation.

4. The year 2023 - Russia's Black Sea Fleet in the Black Sea is in sharp decline

If in 2022 Russia suffered its first shocks at sea, **2023** brought an escalation of naval conflict and a series of spectacular strikes against the Russian fleet. Ukraine diversified its means of attack, introducing *autonomous naval drones* and obtaining from allies long-range aerial cruise missiles (such as the Storm Shadow/SCALP) that could strike harbours used by the Russians. Russia, for its part, tried countermeasures: it moved ships to safer harbours, used barges and nets to protect bases, and increased the use of naval aviation in the Black Sea.

However, the overall trend in 2023 was unfavourable to Russia - its Black Sea fleet continued to lose units and freedom of manoeuvre. By the end of the year, as the British Defence Secretary noted, some *20% of the Black Sea Fleet had been destroyed in the last 4 months*, seriously questioning Russian dominance in the region. Let us review the main events.

Russian consolidation and first drone strikes (January-June 2023)

In the first half of 2023, Russia endeavoured to consolidate its naval positions after the previous year's losses. At the beginning of the year, the Russians still had a significant number of operational warships in the Black Sea: the *flagship* frigate *Admiral MakarovEssen* (one of them taking over the role of the fleet's flagship after the loss of *Moskva*), missile-carrying corvettes (*Buyan-M*), several patrol and desant ships, and Kilo submarines. They have continued to launch Kalibr missile attacks from these naval platforms towards land targets in Ukraine. Every time Russia prepared a missile attack, ships and submarines were observed leaving the harbours (Ukraine frequently reported how many Kalibr launchers are present in the Black Sea, for example in January 2023 announcing that Russia has 4 Kalibr-carrying ships ready to attack).

Still, the Russians have become cautious: after the October 2022 incident (when a Ukrainian maritime drone strike at Sevastopol lightly damaged at least one minesweeper), many major ships have been moved to Novorossiysk or kept under cover behind barrage of nets and barges. The installation of anti-drone nets at the entrance to Sevastopol harbour, the use of smoke masking systems to hide targets and increased air patrols over Crimea were all part of the new Russian defensive posture.

Meanwhile, Ukraine is developing new offensive means. In particular, a flotilla of autonomous naval drones - small, fast unmanned *surface vehicles* (*USV - Unmanned Surface Vehicles*) loaded with explosives and guided to the target remotely - has been created. A first demonstration of the potential of these weapons took place on 29 October 2022, when Ukraine launched a combined attack with 7-9 naval drones and several aerial drones on the Sevastopol naval base. This was the first attack of its kind in history: the maritime drones (each the size of a larger skyjet, with several hundred kg of explosives) attempted to penetrate the harbour and strike the docked ships. The Russians managed to destroy some of the drones before impact, but at least one minesweeper - the *Ivan Golubeț* - was damaged, and there are indications from the frigate *Makarov* (also targeted) that a drone filmed at very close range before being neutralised. The October 2022 attack didn't sink any large ships, but it showed a profound change: even the Russian Fleet's main harbour, Sevastopol, was no longer a safe sanctuary.[25]

In 2023, Ukraine perfected this capability. In January-February, isolated incidents continued (for example, on 16 January 2023 Russian air defences in Sevastopol shot down a drone, a sign that attacks were frequent). But major naval drone strikes returned in the summer:

a) On 22 March 2023, three Ukrainian maritime drones struck again off Sevastopol. Russia claimed to have neutralised them before they hit their targets, but reports indicated explosions in the area.

b) On 24 May 2023, the Russian radio reconnaissance vessel *Ivan Khurs* (Project 18280) was attacked by maritime drones in the Black Sea north of the Bosphorus while returning from the Mediterranean. Ukrainian video footage showed a drone approaching and possibly hitting the ship. Russia claimed that the *Ivan Khurs* suffered only minor damage and arrived safely in Sevastopol[26] . However, the attack hundreds of kilometres off Ukraine's coast demonstrated the extended range of drone operations.

A turning point was the Ukrainian summer offensive of 2023. In parallel with ground actions, Ukraine stepped up its naval campaign. On 17 July 2023, on the very day Russia announced the termination of the Grain Deal, the Ukrainian Security Service (SBU) again attacked the *Crimean* (Kerci*) Bridge* using two naval drones loaded with explosives, managing to damage a portion of the roadway. The attack underlined the technological maturity of these drones, dubbed *"Sea Baby"*, developed in secret by the Ukrainians.

Also in mid-2023, Ukraine began the gradual recapture of its "eyes" in the Black Sea - it recaptured or neutralised several Russian-occupied offshore platforms and surveillance buoys, thus regaining intelligence-gathering advantages. For example, in August 2023 there were clashes over the *"Boiko*" drilling platforms, and a raid by Ukrainian special forces flew the flag on one of them. These actions extended the range of Ukrainian sensors, allowing early detection of the movements of Russian ships. All in all, the first part of 2023

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[25] Kornegay, Patrick, Jr, and Hayden Toftner. "Lessons from Ukraine in the Black Sea." *Wilson Center*, 2 October 2024. Accessed 5 April 2025. https://www.wilsoncenter.org/microsite/3/node/123859. https://www.wilsoncenter.org/microsite/3/node/123859.

[26] L, Wojciech. "Russian Intelligence Ship 'Ivan Khurs' Hit in the Black Sea." *Overt Defence*, 25 May 2023. Accessed 5 April 2025. https://www.overtdefense.com/2023/05/25/russian-intelligence-ship-ivan-khurs-hit-in-the-black-sea/. https://www.overtdefense.com/2023/05/25/russian-intelligence-ship-ivan-khurs-hit-in-the-black-sea/.

was marked by constant harassment of the Russian fleet, mostly by new means. Russia retaliated by hitting[27] harbour infrastructure whenever it could (including after the grain agreement was abandoned, it intensively shelled the ports of Odessa, Chornomorsk, Reni, Izmail). But more and more, the initiative at sea seemed to shift to Ukraine's side, which was striking selectively and giving clear messages that no Russian ship was out of its range.

Major strikes against the Russian Fleet (August-September 2023)

The second half of 2023 brought Russia's worst losses since the sinking of the *Moskva*. A series of well-coordinated Ukrainian attacks, and their use of high precision, hit Russian warships either at sea or directly at their bases in Crimea. We will detail these key incidents:

(i) Attack of Novorossiysk (4 August 2023)

In the early hours of 4 August, several Ukrainian naval drones attacked the Russian port of Novorossiysk (Krasnodar region), which had become an important haven for Black Sea Fleet ships. The main target was the *Olenegorski Gornyak* (Project 775 *Ropucha*), a large decommissioned ship temporarily stationed here. The attack was captured on video and partially confirmed by the Russian side itself: the *Olenegorski Gornyak* was hit and seriously damaged, being seen tilted sharply to one side (port side) while being towed to the berth by the Russians. Ukrainian sources suggested that the vessel was so badly damaged that it was virtually inoperable (the equivalent of a partial sinking)[28] . *The Olenegorski Gornyak* was a Northern Fleet decommissioned ship on loan to the Black Sea Fleet for the invasion; ironically it became the second largest Russian ship disabled by Ukraine after the *Moskva*. The attack on Novorossiysk was significant for another reason: it showed that even Russian ports are not immune. On the same night, another group of drones struck a Russian oil tanker (*Sig*) near the Kerch Strait, damaging it. These operations directly targeted Russian logistical and energy transport infrastructure, signalling the escalation of the naval conflict in the wider Black Sea.

(ii) Destruction of ships in dry dock at Sevastopol (13 September 2023)

One of the most devastating blows to the Russian fleet came at dawn on 13 September. Ukraine launched an attack with Storm Shadow/SCALP cruise missiles (delivered by Britain and France) on the Sevastopol shipyard. The missiles accurately hit a dry dock where two Russian naval vessels were undergoing repairs: the diesel-electric submarine *Rostov on Don* (B-237, Project 636.3 Kilo Upgraded) and the large

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[27] Armstrong, B.J. "The Russo-Ukrainian War at Sea: Retrospect and Prospect." *War on the Rocks*, 21 April 2022. Accessed 5 April 2025. https://warontherocks.com/2022/04/the-russo-ukrainian-war-at-sea-retrospect-and-prospect/. https://warontherocks.com/2022/04/the-russo-ukrainian-war-at-sea-retrospect-and-prospect/.

[28] Balmforth, Tom. "Russian Navy Vessel Damaged in Drone Attack - Ukrainian Source." *Reuters*, 4 August 2023. Accessed 5 April 2025. https://www.reuters.com/world/europe/russian-navy-vessel-damaged-drone-attack-ukrainian-source-2023-08-04/. https://www.reuters.com/world/europe/russian-navy-vessel-damaged-drone-attack-ukrainian-source-2023-08-04/.

decommissioned ship *Minsk* (BDK- Minsk, Project 775 Ropucha)[29] . The result was impressive: both ships were severely damaged, virtually knocked out of action. Satellite images after the attack showed the *Rostov-on-Don* submarine with a massive hole in its midsection, the hull having been pierced by the explosion. The Storm Shadow missiles probably directly hit the submarine and dropship, causing detonation of munitions and devastating fires. Western sources assessed that the submarine is "damaged beyond economic repair" - in other words, it is unlikely to ever be operational. *The Minsk* has also suffered irreparable damage (destroyed structure and machinery). This was the first time since World War II that a Russian (or Soviet) submarine was destroyed by the enemy. The loss of a modern submarine and a landing ship in a single strike seriously undermined the capability of the Black Sea Fleet. A UK Ministry of Defence report noted that repairs would take many years and that Russia's ability to launch cruise missile attacks from the sea was affected, as *Rostov* frequently launched Kalibr missiles.

(iii) Striking of Fleet Headquarters in Sevastopol (22 September 2023)

Less than two weeks after the dock attack, Ukraine symbolically and operationally targeted the Russian fleet command centre. On 22 September, in broad daylight, a salvo of missiles (presumably Storm Shadow/SCALP) hit the Black Sea Fleet Headquarters building in Sevastopol[30] . Dramatic video footage shows the moment of impact, with a missile penetrating the building and a huge explosion devastating it. Ukraine has officially confirmed the attack, calling it a "successful strike" on the fleet headquarters. The command and human casualties were kept secret by the Russians, but Ukrainian sources initially claimed that dozens of officers, including the fleet commander, Admiral Viktor Sokolov, had been killed or wounded. Moscow denied the admiral's loss, later showing footage of him in a video conference (the veracity of which has been debated). What is certain is that the Fleet General Staff was seriously affected - the historic building was partially destroyed, and the leadership of the fleet was certainly shaken. According to reports in October, Commander Sokolov was nonetheless replaced/dismissed following these failures, although Russian officials have not publicly announced the change. The hit on the Fleet headquarters had a major psychological impact: it demonstrated that Ukraine can touch the symbolic heart of Russian naval power in Crimea, even under the nose of Russian anti-aircraft defences and aircraft.[31]

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[29] Catalin, S.I. "First images of the Russian submarine Rostov-on-Don destroyed in Sevastopol (Photo): what role did Crimean partisans play in carrying out this attack?" *DefenceRomania*, 14 September 2023. Accessed 5 April 2025. https://www.defenseromania.ro/primele-imagini-cu-subarinul-rusesc-rostov-on-don-submarine-distrus-in-sevastopol-foto-ce-rol-au-jucat-partizanii-din-crimeea-in-efectuare-acestui-atac_624551.html. https://www.defenseromania.ro/primele-imagini-cu-subarinul-rusesc-rostov-on-don-submarine-distrus-in-sevastopol-foto-ce-rol-au-jucat-partizanii-din-crimeea-in-efectuare-acestui-atac_624551.html.

[30] https://www.defenseromania.ro/primele-imagini-din-satelit-care-arata-o-lovitura-precisa-data-de-o-racheta-storm-shadow-asupra-postului-de-comanda-al-flotei-ruse-din-marea-neagra_624672.html

[31] Popescu, Sorin. "Ukraine claims 'successful strike' on Russian Black Sea Fleet headquarters." *Agerpres*, 22 September 2023. Accessed 5 April 2025. https://agerpres.ro/2023/09/22/ucraina-revendica-o-lovitura-reusita-asupra-cartierului-general-al-flotei-ruse-de-la-marea-neagra--1173995. https://agerpres.ro/2023/09/22/ucraina-revendica-o-lovitura-reusita-asupra-cartierului-general-al-flotei-ruse-de-la-marea-neagra--1173995.

Destroyed building on the territory of the Russian Black Sea Fleet Command Communications Centre 744, satellite image by Planet Labs, Source Photo: Radio Liberty.

These attacks in August-September 2023 confirmed the sharp degradation of the Russian Fleet. Within weeks, Russia lost:

a) a submarine and two large landing craft (one at the dock, one at Novorossiysk),
b) a modern patrol ship (we'll see in a moment, *Sergey Kotov*, in early 2024, was destroyed),
c) a reconnaissance ship temporarily out of action (*Ivan Khurs*),
d) Coastal air defence installations in Crimea (for example, on 23 August 2023, Ukraine destroyed an S-400 Triumf system at Cape Tarkhankut, weakening the fleet's anti-aircraft cover in western Crimea),
e) Fleet Headquarters as infrastructure and perhaps key personnel.

Commentators noted that "the Russians are very worried about these attacks", starting to move their ships even further out to harbours in the Sea of Azov, which was exactly what the Ukrainians were after. Many Russian ships were hit either at sea or on shore, forcing them to stay as far away from Ukraine as possible. Basically, by the end of September 2023, the Russian fleet was in retreat[32] - geographically (moving east, out of range of Ukrainian systems) and in activity level (drastically reducing offensive patrols).

Impact on the fleet and situation at the end of 2023

By the end of 2023, Russia's Black Sea Fleet is in an unprecedented defensive posture:

a) Confirmed losses - According to the UK Ministry of Defence (Grant Shapps) and other sources, about *a fifth of the fleet's warships had been destroyed or severely damaged from June*

[32] Faulconbridge, Guy. "Ukraine Attacks Forced Black Sea Fleet to Move Warships from Sevastopol, Russian Official Says." *Reuters*, 20 October 2024. Accessed 5 April 2025. https://www.reuters.com/world/europe/ukraine-attacks-forced-black-sea-fleet-move-warships-sevastopol-russian-official-2024-10-20/. https://www.reuters.com/world/europe/ukraine-attacks-forced-black-sea-fleet-move-warships-sevastopol-russian-official-2024-10-20/.

2023 to October 2023. This estimate of 20 per cent in four months, also cited by the international press, emphasises the intensity of Ukrainian strikes by the end of 2023. Among the ships lost were: *Olenegorsky Gornyak* (Ropucha, critically damaged), *Minsk* (Ropucha, destroyed), *Novocearkassk* (Ropucha - we will mention the last strike in December immediately), *Caesar Kunikov* (Ropucha - still operational at that time, but damaged earlier at Berdiansk), *Saratov* (Tapir, lost in 2022), *Moskva* (cruiser, lost in 2022), *Rostov-na-Donu* (submarine Kilo, destroyed), *Askold* (modern corvette, destroyed in November), plus various smaller craft and support ships.

b) Moving assets - After repeated strikes in Crimea, Russia relocated many of its units. The remaining submarines continued to operate out of Novorossiysk (e.g. *Veliki Novgorod* and *Kolpino*), where they were still threatened by attacks (unexplained explosions were also reported at Novorossiysk). Some surface vessels took refuge in the harbour of Feodosia (eastern Crimea) or in the Sea of Azov (Mariupol and Kerci harbours), linked to the rest of the fleet through the Kerci Strait. At Mariupol, patrol vessels and small landing craft were observed far from the range of Ukrainian maritime drones.

c) Attempts at dispersal and protection - The Russians have taken improvised measures: anchoring old barges and ships at harbour entrances to physically block naval drones, installing anti-torpedo nets around important ships, and creating smoke screens on attack alerts. They also began to make increasing use of Naval Aviation patrol and fighter aircraft - as a report in October 2023 noted, Russian naval aviation has taken on an increasingly important role, using Ka-27 helicopters and Su-30 aircraft in drone search and anti-ship attack missions[33] . This was a tacit recognition that Russian surface ships could no longer operate safely and that the Russians were relying on aerial alternatives.

d) More late losses - In the very last days of 2023, Ukraine struck another blow: on 26 December, Ukrainian aircraft launched missiles (Storm Shadow, according to sources) over the Crimean port of Feodosia, hitting the destroyer *Novocearkassk* (BDK-46). Successive explosions and fire indicated the detonation of ammunition on board, and Ukrainian sources said the ship was totally destroyed. Although Russia has not officially confirmed the sinking, satellite images showed *Novocearkassk* virtually gone, with debris still visible. According to Radio Free Europe, even a nearby training ship (UTS-150) was partially submerged by the blast. Again, there were casualties. Thus, *Novocearkassk*, which had survived the damage in 2022, was sunk on the second attempt in 2023.

By the end of 2023, the Russian Black Sea Fleet was severely undermined. As noted analyst Pascal Ausseur[34] , "Today, there is no Ukrainian or Russian warship in the Black Sea [that can operate freely].

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[33] Eurasian Times Desk. "Prefect Kill! Russian Super Sukhoi, Su-30SM, Neutralises 'Serial Drone Attacks' On Crimea." *Eurasian Times*, 1 December 2022. Accessed 5 April 2025. https://www.eurasiantimes.com/russia-scrambles-air-superiority-fighter-su-30sm-to-neutralize/. https://www.eurasiantimes.com/russia-scrambles-air-superiority-fighter-su-30sm-to-neutralize/.

[34] Pascal Ausseur, retired Admiral of the French Navy and Director General of the Mediterranean Centre for Strategic Studies.

Because it is detected, tracked and targeted if you want. This is the first war where things have got to this point." Basically, Russia had become unable to use the Black Sea for force projection or naval offensive operations. Its ships were hiding in distant harbours, and any sortie on the open seas carried enormous risks.

It should be noted that the damage to the fleet also affected the overall Russian strategy: in the absence of safety at sea, the Russians stepped up land-based alternatives. They withdrew from the grain agreement on 17 July 2023, attempting to subjugate Ukraine's economy by total blockade. Ukraine responded by opening an alternative maritime corridor off the coasts of Romania and Bulgaria in defiance of Russian threats. Russia failed to ban navigation in this corridor altogether, partly because of fear of hitting neutral ships and partly because its fleet could no longer venture to impose a blockade near NATO waters.

Thus, the balance sheet of 2023 for Russia has been bleak on the naval front: severe material losses, loss of strategic initiative, degradation of its image as a maritime power, and potential changes of command (amid repeated failures, with the fleet commander and other officers likely to be sanctioned). Russia has sought workarounds, such as announcing its intention to establish a naval base in Abkhazia (Georgia) - far out of Ukrainian range - as Politico reported in October 2023[35] . However, analysts pointed out that the port of Ochamchire in Abkhazia is rudimentary and unsuitable for large ships, so it cannot replace Sevastopol. The intention, however, emphasises Moscow's desperate effort to reassert its naval presence in the Black Sea, whereas at Sevastopol it had become precarious.

In the next chapter we will continue the analysis with the events of 2024 and the situation today (2025), where we will see that the trend has continued: Russia has lost its remaining naval advantage as Ukraine has introduced new capabilities (such as the US-supplied ATACMS ballistic missiles) in naval combat.

5. The year 2024 - Russian fleet in the Black Sea almost completely neutralised

After the heavy blows suffered in 2023, the entry into 2024 found the Russian fleet fragile and on the defensive. Ukraine did not stop its campaign, however, and the first months of 2024 brought spectacular new attacks that sank the last major ships Russia still relied on in the Black Sea. The year 2024 virtually confirmed the operational collapse of the Russian fleet in the region: by its mid-year, Russia had no Kalibr missile carriers afloat in Crimea, and the only remaining launch platforms were submarines (also reduced in numbers) and aircraft. We will review the main events of 2024, although it should be noted that, as this is still an ongoing year (until April 2025 for the purposes of this study), the available information is less and sometimes contested.

[35] https://www.politico.eu/article/vladimir-putin-russia-black-sea-abkhazia-plans-to-build-naval-base-in-georgias-breakaway-region-as-it-pulls-vessels-from-sevastopol-base/

Continuation of naval drone attacks (January - March 2024)

In the first months of 2024, Ukraine continued its successful use of naval surface-to-surface drones (USVs) against Russian vessels. Two major incidents are worth highlighting:

a) Attack on the corvette *Ivanovets* (31 January / 1 February 2024)[36]

At the end of January, special units of the Ukrainian Defence Intelligence Directorate (GUR) - presumably the special forces group "Group 13" - executed a complex attack with a swarm of naval drones on the Russian corvette *Ivanovets* (Pr.1241 Molny/Tarantan, a small bastion carrying anti-ship missiles). The operation took place off the Crimean coast at night. Multiple unmanned explosive craft were used to surround and attack the corvette. A black-and-white video clip released by Ukrainian services shows dramatic footage of the *Ivanovets* being surprised by the explosions and then listing and sinking. On 1 February, Ukraine officially announced that *Ivanovets* had been destroyed in the attack, which was also unofficially confirmed by Russian sources on Telegram. Later, Western officials said it was believed the ship was indeed sunk. The significance of this incident is major: the *Ivanov* was one of the last two corvettes equipped with anti-ship missiles in the Black Sea Fleet. By eliminating it, Ukraine has once again demonstrated the vulnerability of the Russian fleet, even escorted ships, to drone swarm attacks. The ship's estimated value was $60-70 million, but its key feature - speed and manoeuvrability - did not save it. In addition, there were an estimated ~40 sailors on board; the Russians have not released anything about their fate, but it is likely that there were human casualties given the violence of the attack.

Fig. no.7: collage by Defence Romania

b) Attack on patrol vessel *Sergey Kotov* (4/5 March 2024)[37]

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[36] *DefenceRomania*, "Show of force in the Black Sea: Russia sinks captured Ukrainian corvette (Photo/Video)," *DefenseRomania*, 1 September 2023, accessed 5 April 2025, https://www.defenseromania.ro/demonstratie-de-forta-in-marea-neagra-rusia-scufunda-o-corveta-ucraineana-capturata-fot0-video_623721.html.

[37] Gava, Ioan-Radu. "Today's footage of the Ukrainian attack on the patrol vessel Sergei Kotov / video." *DCNews*, 5 March 2024. Accessed 5 April 2025. https://www.dcnews.ro/imaginile-zilei-cu-atacul-ucrainean-asupra-navei-de-patrulare-serghei-kotov-video_951281.html.
https://www.dcnews.ro/imaginile-zilei-cu-atacul-ucrainean-asupra-navei-de-patrulare-serghei-kotov-video_951281.html.

Sergey Kotov (Pr. 22160, modern ocean patrol vessel, entering service in 2021) became the next target. This ship was used by the Russians for patrolling and escorting convoys of ships after the termination of the Grain Agreement - for example, patrolling the eastern mouth of the Black Sea, it monitored potential routes of Ukrainian ships. On the night of 4 to 5 March 2024, according to GUR information, a strike by the *Magura V5* naval drone group *Magura V5* hit *Sergey Kotov* near the Kerci Strait. GUR reported that the ship suffered damage to its stern, port and starboard sides, totalling damage of more than $65m. Ukrainian Navy spokesman D. Pletenciuk, said on TV that "now the ship is lying on the seabed" as a result of direct hits by drones. It has also been reported that *Sergey Kotov* was carrying a Ka-27 (or Ka-29) helicopter at the time of the attack, suggesting that the explosion may have also destroyed the aircraft. Russia has not confirmed the incident, but the independent Astra channel reported rumours about the loss of the ship. On 27 March, Ukrainian sources broadcast images of the wreckage on the seabed of a ship that appeared to be *Sergey Kotov*. If this sinking is confirmed, it is highly significant: the *Sergey Kotov* was one of the newest Russian ships in the Black Sea and the only one of its class (the second identical unit, the *Pavel Derzhayvin*, had been damaged earlier). The Russians would thus have lost virtually all modern surface ships capable of launching cruise missiles. Shortly afterwards, a Ukrainian press release emphasised that there were no Kalibr surface-to-surface missile carriers in Sevastopol.

Fig.no.8: real pictures...suggestive, no copyright

These two attacks - *Ivanovets* and *Sergey Kotov* - showed that Ukraine, though worn down by a year of fighting, entered 2024 with fresh forces and improved tactics, hitting the enemy exactly where it still had some offensive power. The Russian fleet, after these incidents, has basically become a "coastal defence" fleet with no real sea combat capability.

ATACMS and Storm Shadow missile strikes (May - November 2024)

By autumn 2023, the Western allies had supplied Ukraine with other long-range weapons, notably MGM-140 ATACMS (US) tactical ballistic missiles with a range of ~300 km (submunitions variant) and Franco-British SCALP-EG (similar to Storm Shadow) air-to-air cruise missiles. Ukraine had until then lacked the ability to strike precise targets at long distances at sea. With these systems, it was able to expand its target list.

The defining event of the year 2024 (so far) was the destruction of the corvette Ciclon[38] - the Black Sea Fleet's last newly-built bastion capable of launching Kalibr missiles. *The Tsiklon* (Tsiklon) was a Karakurt-class corvette (Project 22800), built at the Zaliv shipyard in Kerci and not entering service until July 2023. This modern ship (70 crew members, capable of carrying 8 Kalibr missiles and equipped with the Pantsir-M air defence system) was the pride of the new Russian naval production, intended to replace the losses. But on 19 May 2024, Ukraine struck the port of Sevastopol by surprise, using two long-range ATACMS missiles (according to Russian military bloggers). The target: the corvette *Țiklon*, which was berthed. The result: according to the Ukrainian General Staff, the *Țiklon* was directly hit and completely destroyed. Initially, the claim showed that a minesweeper (*Kovrovets*) had been hit , but this has been revised: the real target was the *Țiklon*, confirmed by independent Russian sources and subsequent images, and that *the Țiklon* was sunk or damaged beyond repair, marking the last Russian surface Kalibr launcher in Crimea. A Ukrainian spokesman emphasised that after the destruction of the *Țiklon*, *"there are no more surface-to-surface cruise missile carriers based in Crimea"*. Confirmation also came from the Russians, who although officially silent, through Telegram channels acknowledged the hit, and the Russian military for a week organised "search-and-rescue" operations in the area of the wreckage of the *Țiklon*, a sign that the ship was lost.

[38] Onofrei, Nicoleta. "Ukraine confirms a painful loss for Russia: the Corvette Ciclon, from which the Russians were launching Zirkon missiles, was hit by ATACMS." *HotNews.ro*, 21 May 2024. Accessed 5 April 2025. https://www.hotnews.ro/stiri-razboi_ucraina-910005-ucraina-confirma-pierdere-dureroasa-pentru-rusia-corveta-ciclon-care-rusii-lansau-rachete-zirkon-fost-lovita-atacms.htm. https://www.hotnews.ro/stiri-razboi_ucraina-910005-ucraina-confirma-pierdere-dureroasa-pentru-rusia-corveta-ciclon-care-rusii-lansau-rachete-zirkon-fost-lovita-atacms.htm.

Fig. no.9 Corvette Țiklon,

Also in autumn 2024, there were reports of other naval targets being hit. The Ukrainians sank in Sevastopol the Russian submarine Rostov on Don[39] , which was undergoing repairs after having been hit in December on 13 September 2023 and was reportedly targeted in Sevastopol harbour by a SCALP missile, but details remain uncertain and unconfirmed. Oil platforms off Crimea were again attacked (with Ukraine consolidating its control over some of them).

Fig. no.10:Russian submarine Rostov on Don hit dock

In the absence of any Russian naval reaction (the Russian fleet practically stopped going to sea), the maritime conflict in the second half of 2024 focused more on attacking maritime infrastructure and trade. Russia continued to hit Ukrainian ports on the Danube (Reni, Izmail) with Iranian drones, seeking to sabotage Ukrainian exports. In turn, Ukraine retaliated by striking Russian economic naval targets: on 12 August 2024

[39] Muresan, Darius. "A failure literally seen from space: In place of the submarine Rostov on Don sunk by the Ukrainians, the Russians put up a wooden mock-up to deny the sinking." *DefenceRomania*, 16 August 2024. Accessed 5 April 2025. https://www.defenseromania.ro/un-esec-care-se-vede-din-spatiu-la-propriu-in-locul-submarinului-rostov-pe-don-scufundat-de-ucraineni-rusii-au-pus-o-macheta-de-lemn-pentru-a-nega-scufundarea_629750.html. https://www.defenseromania.ro/un-esec-care-se-vede-din-spatiu-la-propriu-in-locul-submarinului-rostov-pe-don-scufundat-de-ucraineni-rusii-au-pus-o-macheta-de-lemn-pentru-a-nega-scufundarea_629750.html.

Ukrainian naval drones struck the Russian tankers *Sig* (second attack on it) and *Afanasi Nikitin*, causing damage.

Another aspect of the 2024 campaign was Ukraine's intensification of special maritime operations: commando raids on the Crimean coast, infiltrators for sabotage (such as putting explosives on ships in port - there were rumours that some mysterious explosions in the port of Sevastopol in 2024 were direct sabotage actions). All these operations keep the Russian fleet under constant tension.

By the end of 2024, the picture was clear: Russia had lost the ability to use its Black Sea fleet effectively in war. With the exception of submarines and aviation, the rest of the naval components were either destroyed or forced into inaction:

a) Two frigates (the *Makarov* and *Essen*) had physically survived, but were staying withdrawn and avoiding engagement by being converted into occasional cruise missile batteries, launching Kalibr from close to the Russian shore. There is speculation that one of them may have left the Black Sea before the Bosphorus closed (but this is uncertain; the frigate *Admiral Grigorovich* is known to have been stuck in the Mediterranean and not returned).

b) The remaining dropships (two Ropucha: *Orehovo-Zuevo* and *Yamal*, plus smaller ones) were hidden in Azov harbours or eastern Crimea. They could no longer carry out offensive missions anyway, with vulnerable bases and depots.

c) The Russian coastal patrol forces in Crimea have been reduced to small boats and armed barges - for example, the Russians have adapted some civilian vessels to patrol the Kerci Strait after the loss of military vessels, and have even armed fishing boats or tugs for security tasks.

d) The only formidable naval weapons left were the Kilo submarines (of the original 6: *Rostov* destroyed, *Veliky Novgorod* and *Kolpino* active, *Novorossiysk*, *Krasnodar*, *Stary Oskol* possibly active - some may be in overhaul). These submarines periodically launched Kalibr missiles from the deep, making them harder to intercept. However, they too were under surveillance: NATO sent P-8 Poseidon patrol aircraft to the Mediterranean and the international Black Sea to monitor submarines as they surfaced. In addition, the sinking of the *Rostov* showed that the docks are not safe for them either.

6. The situation in early 2025

By the first quarter of 2025, the strategic naval situation in the Black Sea area can be summarised as follows:

a) Russian Black Sea fleet largely neutralised

It can no longer operate freely in the western and central Black Sea. Areas off the coasts of Ukraine, Romania and Turkey are virtually off-limits to Russian ships, due to Ukrainian surveillance and weapons range. The Russians limit themselves to a maritime strip near Eastern Crimea and the Caucasus .[40]

b) Russian maritime trade remains at risk

After the collapse of the grain deal, Russia declared any ship bound for Ukrainian ports as a potential target, and Ukraine issued a symmetrical warning against ships bound for Russian ports. In practice, Ukraine has attacked several Russian cargo ships (including in harbours), and Russia has searched or intimidated several neutral merchant ships en route to Ukraine. Direct confrontation was limited, however, as both sides risked complicating the successful establishment of a new naval corridor for exports by sailing close to Romanian and Bulgarian territorial waters. Russia did not attack ships in that area, fearing an incident with NATO. Thus, Moscow's plan to completely strangle Ukrainian exports partially failed. For its own exports (oil, grain), Russia began to depend more on the ports on the Sea of Azov (e.g. the port of Kavkaz, from where ferries and barges cross the Kerch Strait to new railway routes and pipelines. The Ukrainian attack on the *Crimean Bridge* (July 2023) and subsequent ones have made logistics on land more difficult, increasing the role of local shipping (Azov-Crimea ferries). But these ferries are vulnerable to drones, so the Russian logistical situation remains precarious.

We note that by the end of the period under study (2022-2025)***, Russia has suffered a strategic naval collapse in the Black Sea. Instead of projecting power, the Black Sea Fleet became largely immobilised and reduced to local defence roles.*** *As one military analyst has concluded they have not realised that they have lost 20% of their fleet in a matter of months*"[41] , and their historical dominance in the Black Sea is seriously in doubt**. In Appendix 1** I have detailed and fully represented Russian naval losses.

In the following chapters we examine the broader implications of these events: how they affect Russia's economic security and its capacity for strategic maritime projection, what role Ukraine's new technologies and innovative tactics have played in achieving these successes, and, last but not least, what lessons are being learnt for Russia's naval doctrine and for the world's maritime powers.

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[40] Marin, Viorica. "Russia has lost a fifth of its Black Sea fleet in the last four months." *Adevărul*, 27 December 2023. Accessed 5 April 2025. https://adevarul.ro/stiri-externe/europa/rusia-a-pierdut-o-cincime-din-flota-sa-de-la-marea-2327214.html. https://adevarul.ro/stiri-externe/europa/rusia-a-pierdut-o-cincime-din-flota-sa-de-la-marea-2327214.html.

[41] Adevărul editorial staff. "Why Putin wants a naval base in a breakaway territory of Georgia." *Adevărul*, 10 October 2023. Accessed 5 April 2025. https://adevarul.ro/stiri-externe/rusia/de-ce-vrea-putin-o-baza-navala-intr-un-teritoriu-2307084.html. https://adevarul.ro/stiri-externe/rusia/de-ce-vrea-putin-o-baza-navala-intr-un-teritoriu-2307084.html.

7. Impact on Russia's strategic maritime projection and economic/logistical security

Russia's strategic naval naval collapse in the Black Sea has consequences beyond the immediate military framework. The Black Sea Fleet has traditionally been an instrument of regional influence and protection of Russian economic interests in the Pontic Basin and beyond (the Mediterranean). The severe weakening of this fleet and the loss of freedom of action at sea affects Russia's ability to project its maritime power as well as the security of its trade and supply routes.

Diminishing Russia's strategic maritime projection

Before the war, Russia used the Black Sea Fleet not only for local tasks but also as a bridge to the Mediterranean. Its ships would regularly pass through the Bosphorus (under peacetime Montreux rights) to join the Russian 5th Operational Squadron in the Mediterranean, supporting operations such as the one in Syria (Tartus naval base). With the closure of the straits by Turkey to belligerent vessels (from February 2022), the Black Sea Fleet became a captive in its own theatre. Worse, however, after its losses, the fleet cannot even project power inside the Black Sea.

A few points:

a) Inability to militarily threaten NATO littoral states

At the outset of the invasion, questions were being asked whether Russia would challenge freedom of navigation in the Black Sea, possibly by denying access to NATO ships or exerting aggressive pressure (such as the 2021 incident with HMS Defender near Crimea[42]). In 2022-2023, however, the situation was reversed: Russian naval vessels avoided approaching Romanian or Turkish territorial waters for fear of being monitored and possibly attacked. Russia could no longer afford direct provocations to NATO in the Black Sea, given the delicate context. As a result, Russia's influence on NATO's south-eastern flank has diminished. Instead, NATO has increased its aerial surveillance presence (AWACS, drones, P-8 aircraft) and helped to counter mines, providing a greater indirect presence.

b) Reducing influence in the Mediterranean and Middle East

The Black Sea Fleet supplies a good proportion of the ships Russia deploys in the Mediterranean. For example, the cruiser *Moskva* had been deployed in 2015 off Syria, launching missiles and providing anti-aircraft defence. After the loss of the *Moskva* and the Montreux restrictions, Russia remained in the Mediterranean with what ships it already had there (some from the Northern, Pacific and Baltic Fleet deployed before the conflict). Without the ability to send for fresh rotation through the straits, the Russian naval presence in the Mediterranean has stagnated.

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[42] https://en.wikipedia.org/wiki/2021_Black_Sea_incident

Black Sea Fleet ships in the Mediterranean were stuck there (e.g. the frigate *Admiral Grigorovich*), and those in the Black Sea inland could not get out to replace them. With the sinking of the *Moskva*, Russia also lost the only truly "ocean calling" ship in the Black Sea, reducing its ability to carry out remote missions. In addition, the Black Sea Fleet was tasked with protecting Russia's southern flank and projecting power towards the Balkans and the Middle East. By undermining this fleet, Russian strategists had to compensate with the Northern and Pacific Fleets (sending additional units to the Mediterranean on long, circuitous routes via Gibraltar or the Suez Canal). The costs of these measures are high and the Russian naval presence in the Mediterranean has weakened. Thus, Russia has fewer means to directly influence events in areas such as Syria, Libya or the eastern Mediterranean compared to pre-2022.

c) Limiting regional deterrence and response

The powerful Black Sea fleet gave Russia options in a wide range of scenarios - from rapid military intervention (such as a possible landing in Odessa) to reacting to regional crises (e.g. responding to naval incidents around the Bosphorus, pressuring Georgia, etc.). With the losses incurred, these options were drastically reduced. In the autumn of 2023, the Kremlin resorted to indirect threats - for example, announcing plans for a naval base in Abkhazia (Georgia) - partly in reaction to the diminishing Black Sea Fleet. But experts have noted that such a base would be of marginal importance, given limited logistics and geography. In other words, Russia has lost some of its regional leverage. The Black Sea Fleet can no longer, for example, credibly threaten a breakout in the Bugeak or Odessa (which used to keep Ukrainian forces busy), nor can it intimidate littoral states with large naval exercises. Russia's historical dominance in the Black Sea basin is now being challenged or even, as Grant Shapps put it at[43] , "questioned".

d) Forcing Russian ships to shelter away from the conflict zone

Through the blows they have suffered, the remnants of the Black Sea Fleet have moved eastwards, to harbours like Novorossiysk or even the Sea of Azov. This has strategic implications: the further they stay towards the Sea of Azov, the less influence they have on the western part of the Black Sea. Basically, Russia has "pushed" its own fleet into the north-eastern corner of the Black Sea, leaving the north-western part under the de facto control of NATO/Ukraine sensors and weapons. This is a remarkable reversal from the situation in February 2022, when Russia was dictating terms across the Black Sea.

The collapse of the Black Sea Fleet has considerably weakened Russia's ability to project naval power. Although the Northern and Pacific fleets remain strong in other theatres, the importance of the Black Sea cannot easily be offset, as it is Russia's only access to the "warm seas" to the south. The loss of prestige and freedom of action here constitutes not only a military failure but also a geopolitical setback: Russia can no longer consider itself unchallenged in the 'Black Sea fortress'.

[43] https://en.wikipedia.org/wiki/Grant_Shapps

Impact on Russia's economic and logistical security

The Black Sea is not just a military theatre, but also a vital economic artery for Russia:

a) Through the ports of Novorossiysk, Tuapse and Taman, Russia exports massive quantities of oil and petroleum products (essential routes for its budget).

b) Also through the Black Sea, Russia exports grain and imports various goods (although some traffic has been re-routed via the Baltic or Pacific).

c) Crimea, annexed in 2014, is logistically dependent on the bridge over the Kerci (Crimean Bridge) and the naval link with mainland Russia.

The conflict has significantly disrupted these aspects:

d) Grain blockade and Ukrainian counter-blockade

From February 2022, Ukrainian ports were blockaded by the Russians, which created a global grain crisis as Ukraine was a major exporter of wheat, maize and vegetable oil. Under international pressure, the Grains Initiative was finalised (July 2022), allowing a controlled resumption of Ukrainian exports. Russia, for its part, benefited from the agreement because it allowed it to export its own agricultural production more easily (and to obtain promises to lift some agricultural sanctions). When Russia unilaterally withdrew from the agreement in July 2023, it hoped to strangle Ukraine's economy and gain political leverage (possibly by blackmailing grain-dependent African/Asian countries with famine). However, Ukraine's "Ukrainian military successes in the Black Sea" - sinking Russian ships and forcing the fleet to retreat - allowed Ukraine to counter the blockade. Ukraine opened an alternative maritime corridor in August 2023, sending grain ships on the route Odessa - Cape Sarych (Crimea) - Danube Delta - Romanian/Bulgarian coast, taking advantage of shallow waters where Russian submarines cannot operate. Although risky, this corridor has proven effective: by the end of 2023, the volume of Ukrainian exports through the new corridor has come close to the levels during the agreement. Thus, the Russian blockade has largely failed; Russia failed to completely halt Ukrainian exports, and in October 2023 even had to initiate talks (via Turkey and Qatar) on relaunching an agreement, signalling its desire to break the deadlock. By losing the fleet, Russia has also lost the "weapon of blockade" - it can no longer impose its will in the international waters of the Black Sea.

e) Attacks on Russian export/import routes

Ukraine has demonstrated that it can strike not only Russia's military but also its maritime economic targets. For example, the naval drone attacks on the *Sig* and *Olenegorski* tankers *Gornyak Sig* and *Olenegorski Gornyak* (also used to transport fuel) have shown the vulnerability of the Russian oil export circuit through the Bosphorus. One notable incident occurred on 16 November 2022, when an explosion (possibly a Ukrainian underwater drone attack) occurred at the Novorossiysk oil terminal. The British commented that if Ukraine can threaten the Novorossiysk harbour, it is "another strategic challenge" and would further undermine Russia's maritime influence. These risks have prompted Russia to invest in the security of its oil ports, but also to expand its crude oil exports via other routes (to Asia via Baltic ports or by rail). Any increase in transport or insurance costs for Russian oil, caused by the risk of war in the Black Sea, hits the Russian budget

directly. Also, the repeated attack on the Crimean Bridge (July 2023 and then October 2022, July 2023 - several times) temporarily disrupted logistical flows to Crimea. Ferry and train transport from the port of Kavkaz had to be restored under the threat of drones. Similarly, oil depots in Sevastopol and other locations have been hit by Ukrainian drones (e.g. a large fuel depot in Sevastopol burned down in April 2023). We are talking about strikes that affect Russian military logistics (supplying the fleet and troops in southern Ukraine is becoming more difficult) and create additional economic stress.

f) Energy security and maritime critical infrastructure

The Black Sea is also home to gas pipelines and undersea cables. One scenario of concern is the possible extension of the conflict to these infrastructures. For example, Russia operates the TurkStream gas pipeline under the Black Sea to Turkey. If the naval situation had been different (if Russia dominated the sea), it might have threatened the infrastructure of Ukraine or others. But in reality, Russia now also fears for its own infrastructure given Ukrainian capabilities. For example, in late 2023 it was speculated that an explosion on the submarine cables between Crimea and Krasnodar could have been a Ukrainian special operation (not officially confirmed). Regardless, Russia needs to re-evaluate the security of its Black Sea infrastructure with limited resources, given that its fleet has been decimated.

g) Crimean economy and tourism

One aspect often overlooked is the effect on Crimea, which Russia turned after 2014 into a military base as well as a tourist destination for Russians. The war drove tourists away completely (especially after missiles and drones started dropping on the peninsula), hurting the local economy. The blockade of maritime transport also reduced the volume of goods through Crimean ports (Sevastopol, Kerci). In 2023, at the height of the Ukrainian attacks, huge queues formed at the ferry in Kerci, and residents were advised to avoid the harbour areas. Crimea's internal logistical security - supplying the civilian population, industry - was threatened, forcing Russia to devote additional efforts (protecting the Crimean Bridge with barges, reconfiguring supply routes).

Russian naval losses have seriously eroded Moscow's ability to fully secure its maritime economic interests in the Black Sea. Even if Russia does not face a blockade on its own exports (NATO has not imposed one, and Ukraine targets military, not civilian trade), Moscow's frustration is obvious: it has been unable either to strangle Ukraine's economy or fully protect its own flows. At the end of 2023, Russia resorted to bombing Ukrainian energy infrastructure and Danube harbours, but these actions cannot compensate for the loss of maritime control.

One indicator of Russia's concern about this decline has been official rhetoric: since the second part of 2023, Russian authorities have increasingly insisted that their fleet would be "reduced in importance as naval aviation takes over the leading role". Also, proposals such as the creation of a squadron of "training ships" converted into attack drone launching platforms (an idea floated by some Russian commentators) or the use of armed civilian vessels show that Moscow is looking for improvised solutions to the gap left by the military fleet.

Russia's economic security and maritime logistics have therefore been negatively affected:

a) Exports and imports through the Black Sea are subject to increased risks (cost, insurance, potential attacks).
b) The plan to stifle Ukraine's economy through maritime control has failed, with Ukraine continuing to export thanks to its military successes.
c) Crimea, a logistical hub for Russia's operations in southern Ukraine, has become vulnerable and hard to supply.
d) In the long term, investors and trading partners will see the Black Sea as an unstable area, which could translate into economic costs for Russia (and for Ukraine, for that matter, until a peace deal is reached).

All these effects undermine Russia's war effort and put domestic pressure on the leadership in Moscow. A Russia that cannot guarantee the security of its own sea lanes and suffers economic losses will be more vulnerable to sanctions and war fatigue.

8. The role of new technologies, precision weapons and Ukrainian tactics

A key factor in Russia's naval collapse was the ingenious way in which Ukraine, starting from a position of apparent naval inferiority, managed to use new technologies and unconventional tactics to gradually annihilate the Russian fleet. This section analyses the key elements: precision anti-ship missiles, **drones** (aerial and naval), Western-supplied intelligence, and how Ukraine has integrated all of these into a coherent strategy of reverse *Anti-Access/Area Denial* (A2/AD) against the Russians.

Coastal anti-ship missiles and precision strikes

Neptun missiles (Ukraine)

The Moskva cruiser was sunk with two R-360 Neptun rockets, developed by Ukrainian industry (Luch Design Bureau). The Neptun is a modernised derivative of the Soviet Kh-35 rocket, with updated electronics and extended range (over 200-250 km). Although Ukraine had few launchers, it was able to use them decisively against its most valuable target. The strike was aided by surprise and possibly jamming/distraction (there is speculation that a Bayraktar TB2 flew over *Moskva* as decoy, catching the attention of the crew as the missiles arrived at sea level). In any case, the success showed that even a country without a fleet can use anti-ship missiles (AShMs) to strike an invading navy. After *Moskva,* Neptun has been used (not officially confirmed) in other situations, but attention has shifted to other weapons supplied by the West.

Harpoon missiles (Denmark/UK)

In May-June 2022, NATO countries sent Harpoon anti-ship missiles (AGM-84) to Ukraine. These are established Western missiles, ~150 km range, active radar, 225 kg warhead, flexible platform (launchable

from truck, ship or aircraft). Denmark has sent Harpoon coastal launchers and the UK adapted rockets. With Harpoon, Ukraine extended the threat to Russian ships. The tug *Vasili Beh* was sunk by the Harpoon, and unofficial reports suggest that the destroyed *Serna* near the Serpents and other targets were also hit by Harpoon. The moral impact was major: the Russians knew of the Harpoon's reputation (from the Falklands War and other conflicts), so the presence of this weapon forced them to withdraw even further away from valuable ships, fearing stealth attacks. Harpoons supplemented the Neptun capability, giving Ukraine a larger stockpile of reliable missiles.

Storm Shadow / SCALP missiles (UK / France)

These are not traditionally anti-ship, but aerial cruise missiles for land targets, but Ukraine has used them very effectively against ships in harbours. With ~250 km range and a combined guidance system (GPS + terrain contour + IR at the end), the Storm Shadow's Storm Shadow has high accuracy and a ~450 kg warhead, optimised for bunker-busters. Supplied to Ukraine in May 2023, they have been a *game-changer*: the September 2023 attack on the submarine *Rostov* and the ship *Minsk*[44] , as well as the November 2023 attack on the corvette *Askold*[45] in the Kerci dock, were both carried out with Storm Shadow (or the French SCALP variant). The accuracy of these strikes demonstrates that cruise missiles can annihilate stationary naval targets even more effectively than guided bombs. Russia's attempts to intercept them proved insufficient - Sevastopol's anti-aircraft defences (S-300, Pantsir) were penetrated.

ATACMS ballistic missiles (USA)

In October 2023, the US supplied the first ATACMS missiles (MGM-140A variants with sub munitions, range ~165 km). These have been used with devastating effect on airfields (e.g. destruction of 9 helicopters at Berdiansk and Luhansk), but also against ships. At least in the case of *Tiklon*, it appears that ATACMS were used (possibly the unitary warhead variant if it existed, or a precision strike with M39 variants). ATACMS has ballistic trajectory, coming from above at high speed, making it difficult to intercept and hitting the decks of ships (where the armour is weak) The Russians have not faced such a threat to ships before. The use of ATACMS against *Tiklon* surprised - basically, a system designed to hit land targets has been adapted by the Ukrainians to naval targets. This innovation broadens the spectrum of the anti-ship arsenal: not just low cruise profile missiles, but ballistic trajectories can be lethal to stationary ships.

HIMARS hits harbour infrastructure

It's worth noting that Ukraine has also used HIMARS launchers (70 km GMLRS missiles) to hit naval targets when they were within reach. For example, the attack on *Novocearkassk* at Feodosia (December 2023) was made possible by the Storm Shadow missile, but in July 2022 there was an episode when the Ukrainians

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[44] S.I. Catalin. "First images of the Russian ship 'Minsk' after being hit by missiles (Video): How extensive is the damage and why is repairing it difficult?" *DefenceRomania*, 15 September 2023. Accessed 5 April 2025. https://www.defenseromania.ro/video-cu-avarierea-navei-mari-de-asalt-amfibiu-minsk_624571.html. https://www.defenseromania.ro/video-cu-avarierea-navei-mari-de-asalt-amfibiu-minsk_624571.html.

[45] Soare, Cristian. "First images from the recent missile attack on the Crimean Peninsula (Photo/Video): the Ukrainians targeted the Kerci shipyard." *DefenceRomania*, 5 November 2023. Accessed 5 April 2025. https://www.defenseromania.ro/santierul-naval-din-kerci-atacat-cu-rachete_625402.html. https://www.defenseromania.ro/santierul-naval-din-kerci-atacat-cu-rachete_625402.html.

hit the Herson bridge[46] leading to Crimea with HIMARS. In the future, the new 150 km GLSDB missiles (glide bombs launched from HIMARS) could also target harbours.

Intelligence and assisted targeting

The successful use of these precision weapons has also depended on high-quality targeting information. It is common knowledge that NATO countries have provided Ukraine with surveillance data (satellite imagery, data from P-8 Poseidon aircraft, Global Hawk drones, etc.). Thus Ukraine knew the positions of Russian ships in real time many times. For example, the US was reported to have helped in locating *Moskva* (which was suggested in the press, though not officially, and provoked discussion). In addition, activists and OSINT (Open Source Intelligence) were playing a role - Oryx and other platforms were visually tracking confirmations. Indirectly, NATO created an "intelligence funnel" that allowed Ukraine, with its own forces, to strike as if it had the eyes of a superpower. A clear sign: immediately after each successful strike, the Western reaction has been muted, suggesting real but undeclared involvement.

Aerial drones and asymmetric warfare

Bayraktar TB2 drone

Purchased from Turkey before the war, Bayraktars became famous in the early months for destroying tanks and anti-aircraft systems. On the naval front, the TB2 had a moment of glory on Snake Island, where it sank Russian boats (e.g. a Serna-class Desant Class[47] on 7 May 2022,) and annihilated a helicopter on the island. The TB2 was also used for naval reconnaissance and probably in aid of *Moskva* targeting (distraction as speculated). Over time, Russia brought in more anti-drone systems, diminishing the effectiveness of the TB2. But they remain an example of how a relatively cheap drone can weaken a superior enemy with disproportionate casualties (TB2 cost several million $, *Moskva* was worth hundreds of millions).

Drone aerial kamikaze

Ukraine has also developed indigenous kamikaze aerial drones (e.g. *UJ-22 Airborne* model or other homemade ones) to strike targets in Crimea. Case in point: in August 2023, a drone hit a P-800 radar on the roof of a block in Crimea[48] . In the naval context, aerial drones have been used more to jam defences, e.g. in

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[46] Muresan, Darius. "HIMARS hit Russian territory. Ukrainians destroyed a strategic bridge in Kursk managing to isolate over 700 Russian soldiers." *DefenceRomania*, 17 August 2024. Accessed 5 April 2025. https://www.defenseromania.ro/himars-au-lovit-teritoriul-rusiei-ucrainenii-au-distrus-un-pod-strategic-din-kursk-reusind-sa-izoleze-peste-700-de-soldati-rusi_629768.html. https://www.defenseromania.ro/himars-au-lovit-teritoriul-rusiei-ucrainenii-au-distrus-un-pod-strategic-din-kursk-reusind-sa-izoleze-peste-700-de-soldati-rusi_629768.html.

[47] Dumitrache, Ciprian. "'Both sank'. Two Russian decommissioned Russian naval warships destroyed by Ukrainian maritime drones." *DefenceRomania*, 10 November 2023. Accessed 5 April 2025. https://www.defenseromania.ro/ambele-nave-s-au-scufundat-se-profileaza-inca-o-lovitura-dura-incasata-de-flota-rusa-urmatoarele-pe-lista-doui-nave-amfibii-din-clasa-serna_625483.html. https://www.defenseromania.ro/ambele-nave-s-au-scufundat-se-profileaza-inca-o-lovitura-dura-incasata-de-flota-rusa-urmatoarele-pe-lista-doui-nave-amfibii-din-clasa-serna_625483.html.

[48] Digi24. "Ukrainian drones hit several Russian air defence systems, ships, a Mi-8 helicopter in Crimea." *Digi24*, 19 March 2025. Accessed 5 April 2025. https://www.digi24.ro/stiri/externe/drone-ucrainene-au-lovit-mai-multe-sisteme-rusesti-de-aparare-aeriana-nave-elicopter-mi-8-in-

conjunction with naval attacks (the October 2022 attack on Sevastopol also involved aerial drones as a diversion). They put pressure on Russian defences, forcing them to consume anti-air missiles.

Reconnaissance drones and commercial satellites

Ukraine has also harnessed commercial satellite imagery and small reconnaissance drones (such as the *Leleka* or *Furia*) to monitor Russian harbours. Knowing whether, for example, a ship is still at the dock or has sailed can make all the difference in planning an attack.

Naval drones - a new era of war at sea

Perhaps Ukraine's most innovative contribution to the art of naval warfare is the large-scale use of unmanned naval drones (USVs). In the Russian-Ukrainian conflict, we are seeing the first decisive use of such means.

Ukrainian naval drone concept

The first prototypes appeared in 2022, and in 2023 Ukraine formalised the creation of a force of "maritime drones". These USVs have a low-profile, semi-submersible design (partially submerged to be hardly detectable by radar), length ~5-6 metres, explosive payload ~200 kg. Propulsion is by thermal engine (sonic dismastable). They are equipped with video cameras and remote data link. The unit cost is estimated at tens of thousands to several hundred thousand dollars - much cheaper than a ship or missile, allowing swarm attacks. Ukraine has baptised them with names such as *Sea Baby*[49] or uses the technical name *Magura V5*.

Drone swarm tactics

The successful attacks (Sevastopol October 2022, Novorossiysk August 2023, Ivanovets February 2024, Sergey Kotov March 2024) have in common the use of several drones simultaneously, coming from different directions, trying to saturate the defences. A ship has limited weapons against such an attack: on-board cannon (AK-630) or marine rifles. Anti-aircraft systems like Pantsir-M are not designed for very small and fast sea-level targets. The Russians improvised - firing heavy machine guns from the bows of ships, or attempting evasive manoeuvres. But when 5-6 exploding boats come in, it's difficult to stop them all. Even if 4 are destroyed, one hit is enough to incapacitate a big ship. The attack on the *Ivanovets* is emblematic: several drones bypass the corvette's fire and hit it. Another example is *Olenegorski Gornyak*: probably only one drone out of several probably hit its target in the end, but that one also knocked the ship out of action.

Long-distance operations

Naval drones have also demonstrated long-range capabilities. The attack on Novorossiysk is estimated to have travelled over 700 km (if launched from southern Ukraine). Some launches may also have been made from close to the targets, using clandestine cells (speculation about possible launches from civilian boats near Russian harbours). However, *Sea Babies* can navigate hundreds of kilometres, guided by GPS. They can be

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crimeea-3163587. https://www.digi24.ro/stiri/externe/drone-ucrainene-au-lovit-mai-multe-sisteme-rusesti-de-aparare-aeriana-nave-elicopter-mi-8-in-crimeea-3163587.

[49] Axe, David. "Ukraine's Sea Baby Drone Boats Shoot Back Now." *Forbes*, 9 December 2024. Accessed 5 April 2025. https://www.forbes.com/sites/davidaxe/2024/12/09/ukraines-sea-baby-drone-boats-shoot-back-now/. https://www.forbes.com/sites/davidaxe/2024/12/09/ukraines-sea-baby-drone-boats-shoot-back-now/.

programmed to follow detour trajectories, possibly coming from offshore, where the Russians would least expect them. Thus, Ukraine was able to attack harbours in the heart of Russian territory (Novorossiysk, Tuapse) without having nearby naval bases - unthinkable in a classical paradigm.

Russian counter-measures

To counter naval drones, the Russians have:

a) Installed physical barriers, anti-submarine nets at harbour entrances, inflatable booms (booms), boats and barges placed as obstacles. Thus at Sevastopol, after the 2022 attack, they often kept a tugboat at the entrance with a chain between the breakwaters overnight.

b) Used radio-electronic jamming equipment to break the link between drone and operator. Some Ukrainian drones seem to have semi-autonomous mode (supposed on-board intelligence that continues the mission if it loses contact). However, jamming doesn't guarantee stopping - if the drone is already close, inertia may bring it on target.

c) Deployed patrols and reconnaissance with planes, helicopters searching south of Crimea for "suspicious boats". For example, the Russians reported destroying naval drones in the Black Sea in September 2023. But any such interception is difficult - they can't survey the whole sea non-stop.

d) Exploited weather conditions, given that small drones are harder to operate in rough seas. The Russians may try to schedule naval activities only when the sea is rough (paradoxically, storms become their "ally"). But that's not certain either - a drone can also sail in big waves, only with an increased risk of sinking.

Overall, naval drones have given Ukraine a tool to even the scales in Black Sea waters, similar to how cheap aerial drones (Shahed) have given Russia a tool to strike deep into Ukraine's infrastructure. It is an example of the *democratisation of military technology*, where an unconventional, inexpensive system can neutralise valuable traditional platforms (warships).

One might think that, given their use by the Ukrainians in the Black Sea, surface drones loaded with explosives were "decisive" for a naval battle in the future. The reality is more nuanced. Indeed, although they kept the Russian fleet at bay, the drones were relatively rarely the cause of losses to the latter.

The majority of Russian ships destroyed or damaged were as a result of cruise missile attacks or those launched from the coast or dedicated to land combat, with the strikes being carried out in harbours (approx. 30%). There were indeed maritime drone actions, but they were marginal (16.7%) as was the effect of sea mines (13.3%).

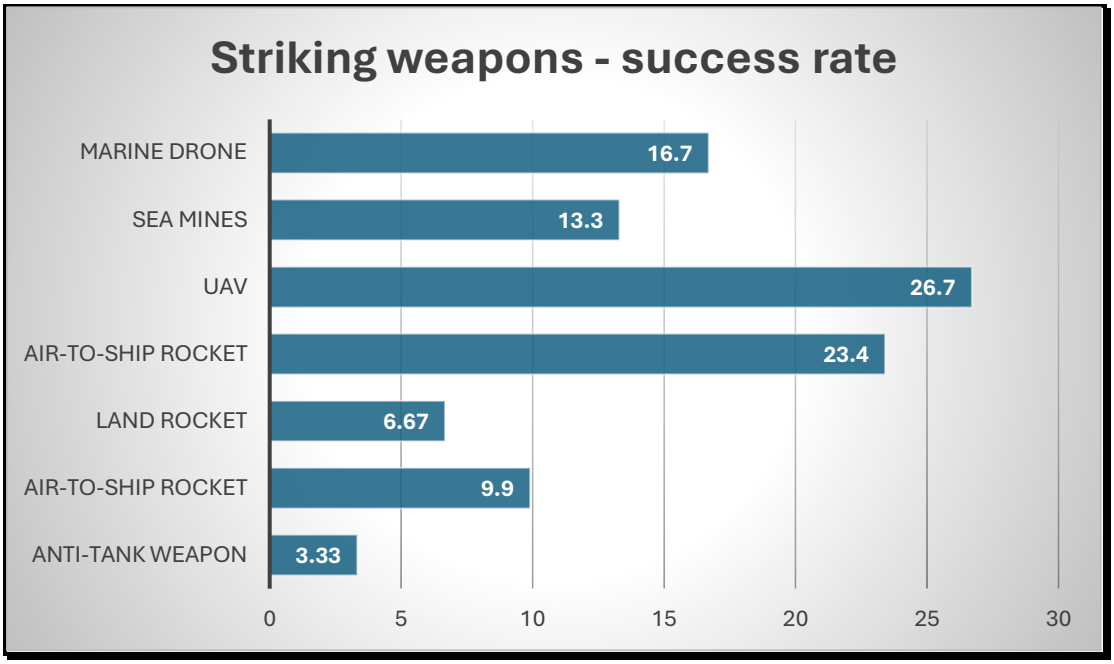
Anti-ship missiles (Neptun and Harpoon), launched from the coast, have contributed to a 10% success rate, but we have to take into account the lack of Ukrainian ships and especially the shift in the range of the Russian Federation's ships towards the eastern Black Sea basin.

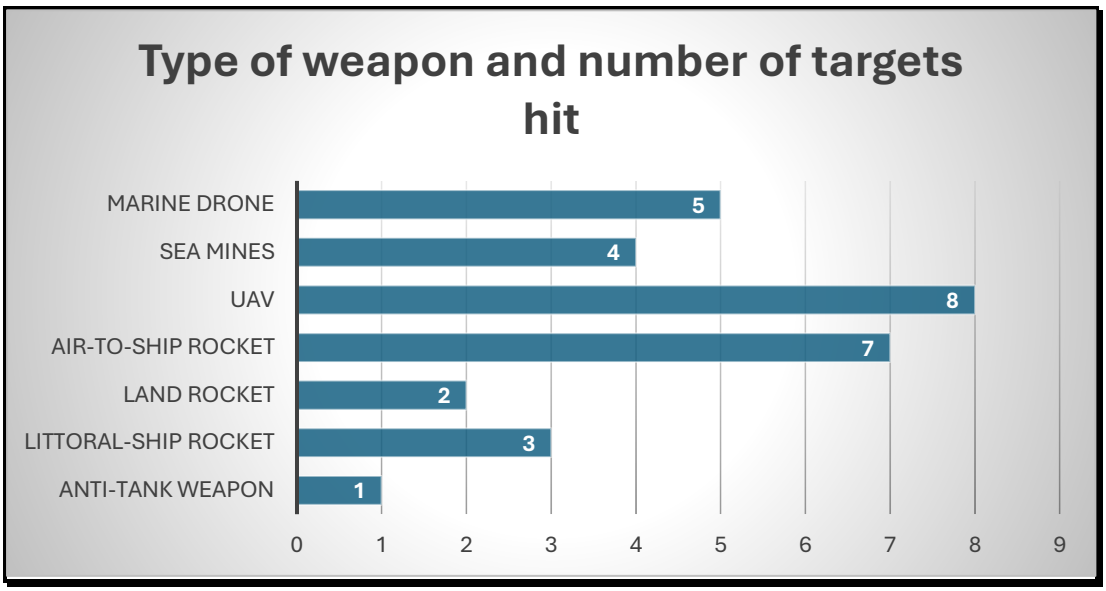
The analysis was based on the following data:

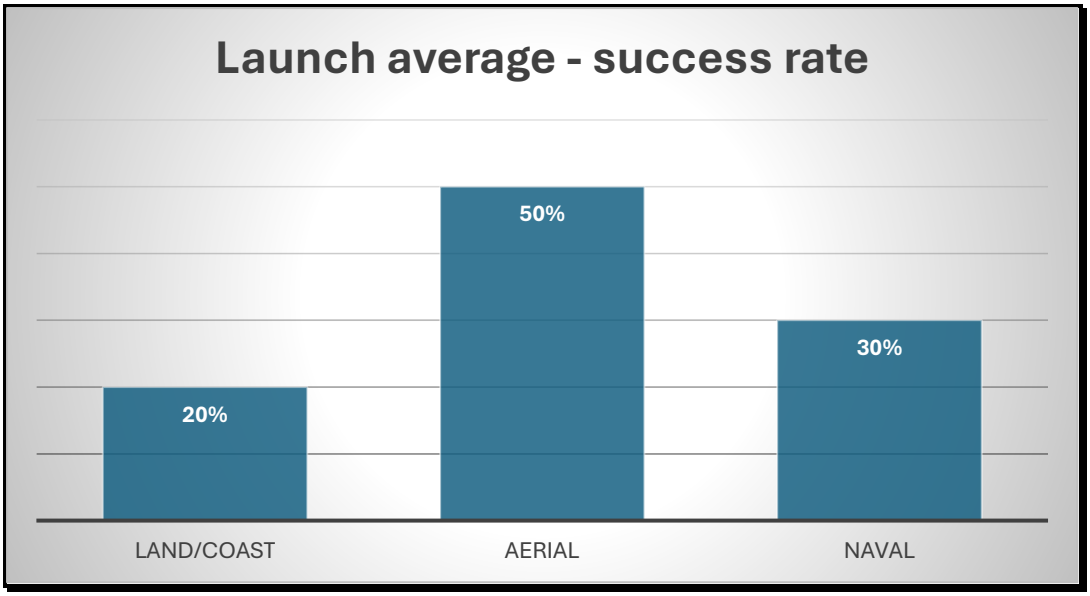
Armament type	Targets hit	Percentage
Anti-tank weapon	1	3,33%
Littoral-Ship Rocket	3	9,9%
Land rocket	2	6,67%
Air-to-Ship Rocket	7	23,4%
UAV	8	26,7%
Sea mines	4	13,3%
Marine Drone	5	16,7%

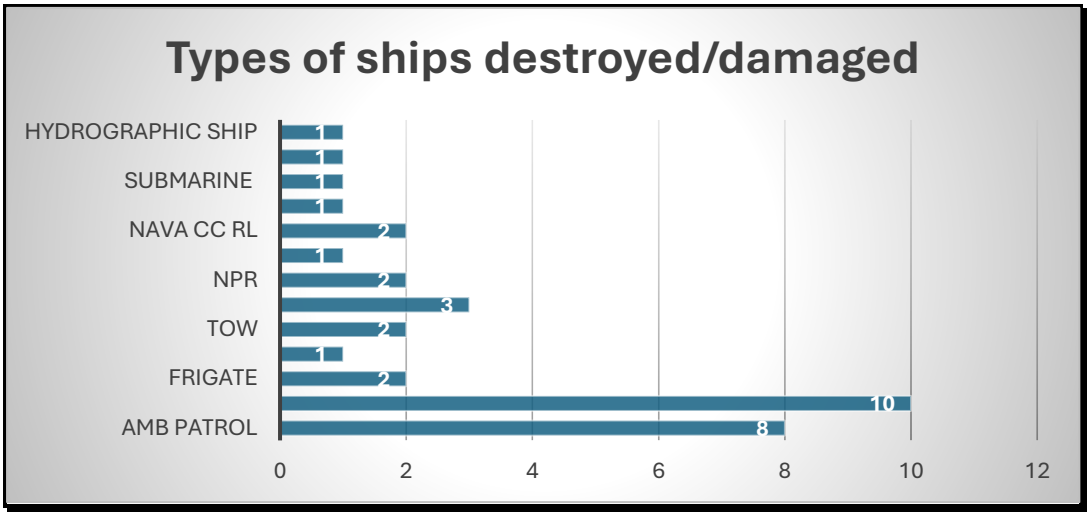
Fig.nr.11: Percentage of targets hit

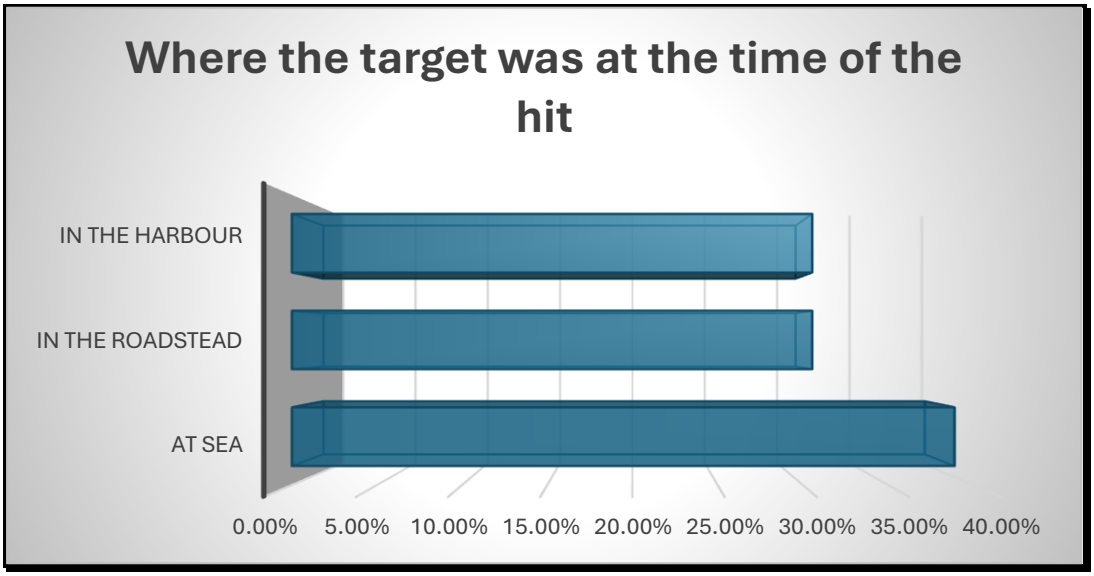
The data are interpreted in the graphs below:











Group of Figures 12 is the author's creation

Ukrainian "hybrid warfare" tactics in the naval field

a) Ukraine has combined these technologies in a strategy of constant harassment and surprise attacks:

b) Simultaneous multi-domain attacks

Many actions used combinations: naval drones + aerial drones, missiles + drones, sea attack + land diversion (for example, on the night of the attack on *Sergey Kotov*, Ukraine intensively bombed land targets in the south, so the Russians' attention was divided).

a) Targeting Russian centres of gravity

Ukraine has methodically chosen high-value targets: *Moskva* (centre of gravity - anti-aircraft), *Saratov* (strategic transport), *Rostov submarine* (underwater cruise capabilities), *Minsk/Novocearkassk* (amphibious transport), *Ivanovets/Askold/Tsiklon* (missile-carrying vessels). And then Fleet HQ (command centre). Basically, one by one he decapitated the key components of Russian naval power. The strategy is reminiscent of NATO's concepts of *"disarming strike"* on the adversary's A2/AD network, but here applied in reverse - Ukraine created an A2/AD against the invading fleet.

b) Maximising the psychological effect

Each success was publicised by Ukraine (and partners) to highlight Russia's vulnerability. Example: after the Sevastopol HQ hit, the Ukrainian Defence Ministry triumphantly posted: *"We promise there will be more"*[50] . This *psy-ops* has demoralised Russian sailors. In wiretap reports, sailors complained to their families of fear, with some refusing to sleep on the ships (a case recounted at one point on Ukrainian channels). Incidentally, the Russians moved many crews away and dispersed their HQ staff after the attack.

c) Resilience and adaptability

Ukraine has also suffered setbacks (e.g. the attempt to retake the Serbs in late May 2022 resulted in the loss of a troop carrier in an air ambush, and some helicopters). But he learnt quickly: instead of a direct assault, he favoured *"erosion*" - repeated bombardments until the Russians were off the island. The same philosophy was applied to the fleet: first they cut off its "umbrella" (*Moskva*), then its "tentacles" (the pier, Bayraktar drones), then increasingly daring attacks. The incremental campaign was calculated to minimise Ukraine's risks - it didn't send men or ships to direct sacrifice, everything was remote or unmanned.

d) Co-operation with allies

By implication, the tactic implied close relations with the West. The fact that American sources confirmed (off the record) that the US did not explicitly tell Ukraine not to strike Crimea gave the tacit green light. Moreover, arms deliveries (Harpoon, Storm Shadow, ATACMS) were calibrated with successes on the ground. Each Ukrainian innovation was followed by additional support: after *Moskva*, the West started serious anti-ship talks; after the drone strikes, the UK/France sent SCALP; after the grain corridors held, the US sent ATACMS etc. It is clear that without Western support, Ukrainian successes would have been much more limited - but to Ukraine's credit, it proved that it knew how to use that support effectively, which incentivised partners to offer more.

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[50] Mazurenko, Alona. "Security Service Service Head Reveals Where Unique Ukrainian Sea Baby Drones Are Assembled." *Ukrainska Pravda*, 16 August 2023. Accessed 5 April 2025. https://www.pravda.com.ua/eng/news/2023/08/16/7415775/.

All these technological and tactical elements have paradoxically made it possible for a country without a surface fleet (Ukraine) to "hit or disable one third of Russia's Black Sea Fleet" by 2023, forcing the rest of the fleet to withdraw[51] . It is a historic lesson in the art of war: asymmetry and innovation can defeat numerical and classical superiority. This is not new (examples: torpedoes and cheap naval mines sinking battleships in the 20th century), but scale and complexity show a leap forward. Modern naval warfare seems to be entering a phase where large platforms (cruisers, aircraft carriers) are extremely exposed unless they have total air dominance and impeccable air defences. Russia lacked both in the Black Sea: it had no naval aviation capable of cover (AWACS drones or full air superiority, because Ukraine's air force was still operating and defending the coastline), and ship-based air defences proved insufficient in the face of target saturation and enemy intelligence.

Next, we will see how these practical lessons are beginning to influence Russian naval doctrine and global military thinking about war at sea, and what changes are in the offing in the way fleets operate.

Main characteristics of the weapon/means of striking

Skif anti-tank weapon

The Skif anti-tank weapon, also known as Stugna-P or Stuhna-P, is a Ukrainian anti-tank guided missile (ATGM) system developed in the early 2010s by Luch Design Bureau, a unit of UkrOboronProm. Skif's original PN-S (ПН-С) guidance device was originally developed and manufactured by Peleng Design Bureau based in Minsk/Belarus.

Skif is designed to destroy modern armoured targets with combined or monolithic armour, including Explosive Reactive Armour (ERA). Skif can attack both stationary and moving targets. It can be used to attack both from long range (up to 5 kilometres during daylight) and from a minimum range of 100m. It can attack point targets such as gun emplacements, lightly armoured objects and helicopters, but has also proved effective against craft at sea at effective range. The Skif has two targeting modes: manually aimed and automatic fire-and-forget, which does not use manual tracking of a target. In 2018, an improved export variant of Skif was tested by the Ukrainian military.

The Skif ATGM should not be confused with the Stugna 100 mm anti-tank missile.

R-360 "Neptun"

R-360 "Neptun" is a Ukrainian anti-ship cruise missile. It was designed by Kiev's "Luci" Design Bureau in 2014-2020. In 2020 the RK-360MȚ "Neptun" coastal complex based on this missile was adopted by the Armed Forces of Ukraine.

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[51] Hoorman, Chloé, and Elise Vincent. "Ukrainian Naval Drone Attacks Force Russian Fleet Out of Crimea." *Le Monde*, 22 July 2024. Accessed 5 April 2025. https://www.lemonde.fr/en/international/article/2024/07/22/ukrainian-naval-drone-attacks-force-russian-fleet-out-of-crimea_6694576_4.html. https://www.lemonde.fr/en/international/article/2024/07/22/ukrainian-naval-drone-attacks-force-russian-fleet-out-of-crimea_6694576_4.html.

The missile is designed to destroy ships with a displacement of up to 5,000 tonnes and has a warhead with a mass of 150 kg. Its range is up to 280 km. The missile has a subsonic speed (900 km/h) and flies at very low altitudes - a few metres above sea level. The rocket can manoeuvre in flight.

The missile can be operated from three platforms: naval, land and air. In 2019, a land-based complex - RK-360MȚ was built, which consists of several machines: command post, launcher, transport and loading machine, etc. As a naval platform for this missile, "Doe" type stars were initially considered, but since 2018 Vespa type stars.

Harpoon anti-ship missile

The Harpoon anti-ship missile is a dedicated anti-ship missile. It has been developed in several advanced versions, including *SLAM* (Stand-off Land Attack Missile) derivatives for high-precision attacks on land targets. The Harpoon and *SLAM* will remain in service with the US Navy for the foreseeable future, but they have been fitted to the Turkish-built F211 - "Hetman Ivan Mazepa" and F-212 - "Hetman Ivan Vyhovskyi" (ADA class) corvettes, but not yet delivered. Current US platforms for the AGM-84 are the Navy's F/A-18, P-3C and S-3B F/A-18s and also some USAF B-52Hs. The AGM-84E4E/H/K *SLAM* is currently used only by the F/A-18.

After the sinking of the Israeli destroyer *Eilat* in 1967 by Soviet-built anti-ship missiles, the US Navy saw the need to develop a dedicated anti-ship missile and, as a result, Harpoon's primary mission became attacking surface ships. The development project was officially begun in 1968, and the ZAGM-84A missile designator ZAGM-84A was assigned in 1970 after the Navy issued a formal request for proposals.

In June 1971, McDonnell-Douglas was awarded the prime contract for Harpoon, and the first test rocket flew in October 1972. By then, it had already been decided to develop air-launched, ship- and submarine-launched variants of the Harpoon, called the AGM-84A, RGM-84A and UGM-84A, respectively. As the range requirement was increased to 90 km (50 Mm), turbojet propulsion was selected by McDonnell-Douglas. Harpoon production began in 1975, and the first version to enter service was the RGM-84A in 1977, followed by the AGM-84A on P-3 aircraft in 1979. UGM-84A became operational on attack submarines in 1981. There are also unarmed training versions of the AGM/RGM/UGM-84A, called the ATM-84A, RTM-84A and UTM-84A. The RGM-84A is usually launched from MK 140 (light weight) or MK 141 (shock-hardened) canister launchers, which contain four missiles, but MK 112 (ASROC) or MK 26 (standard) launchers can also be used. The RGM-84A has folding wings and fins that flip up immediately after exiting the launcher. For target acquisition and tracking, Harpoon-equipped surface ships use the AN/SWG-1 Harpoon fire control system.

The MK 117 digital fire control system has full integrated Harpoon support. So far, over 7000 Harpoon anti-ship missiles (including production for foreign countries) and 1000 *SLAM* variants have been built, *of which Turkey has a substantial stock, which it wants to replace with indigenous anti-ship missiles*. Production of anti-ship missiles continues for customers outside the US, while production for the US Navy will continue with the AGM-84K *SLAM-ER* ATA.

Specifications:	AGM-84D	RGM/UGM-84D	AGM-84E	AGM-84F	AGM-84H/K
Length	3.85 m	4.63 m	4.50 m	4.44 m	4.37 m
Anvergence	91.4 cm				2.43 m
Diameter	34.3 cm				
Weight	540kg	690kg	627 kg	635kg	725 kg
Speed	Mach 0.85				
Range	220 km (120 Mm)	140 km (75 Mm)	93 km (50 Mm)	315 km (170 Mm)	280 km (150 Mm)
Propulsion	Engine: Teledyne/CAE J402-CA-400 turbojet; 3.0 kN Booster (RGM/UGM-84 only): A/B44G-2 or -3 Solid Fuelled Rocket; 53 kN for 2.9 sec				
Spotlights	221 kg WDU-18/B penetrating fragmentation-explosion				360 kg WDU-40/B Penetrant BF

Fig. no.13 represents Harpoon missile variant specifications.

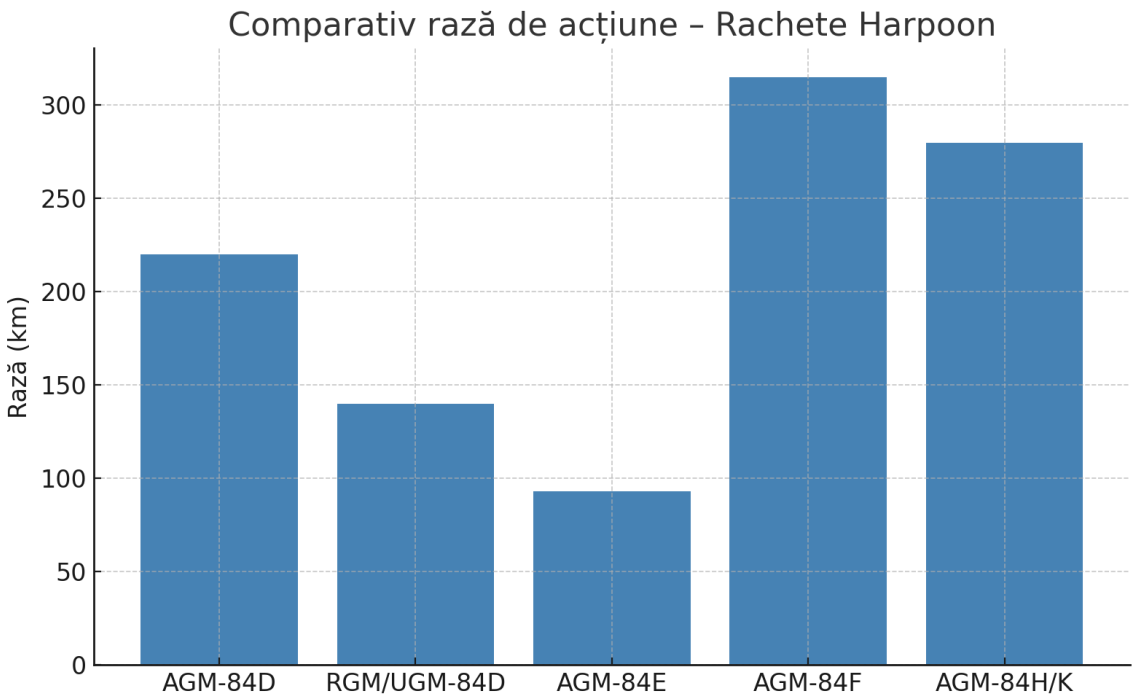

Fig. No 14 Range of the Harpoon spider

STORM SHADOW/SCALP-ER

STORM SHADOW/SCALP is a long-range, conventionally armed, deep-strike, air-launched, air-launched weapon designed to meet the demanding requirements of pre-planned attacks against high-value stationary or fixed targets such as hardened bunkers and key infrastructure.

The SCALP EG and Storm Shadow missiles are virtually identical in all respects, except that they are equipped with different aircraft interface components and software. The rockets are 5.1 m long, have a hull diameter of 630 mm, weigh 1,300 kg and have a range of 250-400 km. The SCALP EG/Storm Shadow is

equipped with a TRI-60-30 Microturbo engine and a payload of 400 kg. The missiles are intended to have a shelf life of 12 years when fully fuelled and stored in sealed containers.

The SCALP EG/Storm Shadow is guided by a triple navigation system using inertial navigation, GPS and terrain reference navigation. These advanced navigation systems, combined with an infra-red seeker and automatic target recognition algorithms, allow the missile to effectively hit the intended point of impact under severe conditions.

Able to be operated day and night in all weathers, the weapon offers a highly accurate planned depth-attack capability. The STORM SHADOW/SCALP's exceptional accuracy is due to its advanced navigation system that combines INS, GPS and terrain references. After launch, the weapon descends to terrain hugging altitude to avoid detection. When approaching the target, its on-board infrared seeker matches the target's image with the stored image to ensure a precision hit and minimal collateral damage.

Rocket variant:

Version	SCALP EG/Storm Shadow	SCALP Naval
Beat	550 kilometres	1,000 km (submarine launched, 1,400 km (ship launched)
Speed	Mach 0.95 (323 m/s)	Mach 0.95 (323 m/s)
Launch platform	Air Launched - Mirage 2000, Rafale, Su-24, Tornado, Typhoon, Gripen	Ship/submarine
Spotlights	1X400 kg HE Penetrate	Multifunctional 300 kg HE
Diameter	630 mm	500 mm
Weight at launch	1,300 kg	1,400 kg
Countries with missiles	France, Greece, Italy, Saudi Arabia, United Kingdom	France

Fig. 15 represents the SCALP rocket

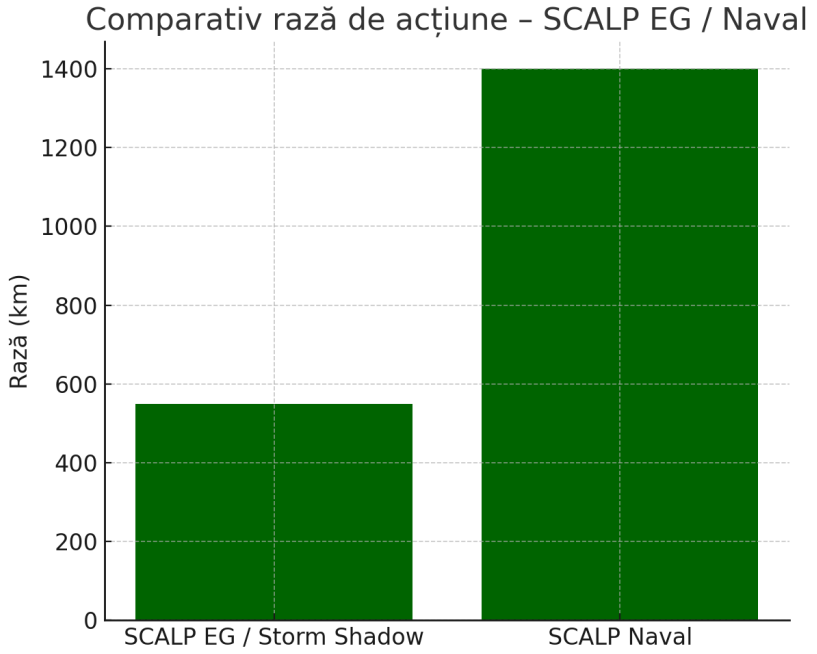

Fig. no.16 represents the range of the SCALP rocket

OTR-21

The OTR-21 is a mobile missile launch system designed to be deployed with other ground combat units on the battlefield. While the 9K52 Luna-M is large and relatively inaccurate, the OTR-21 is much smaller. The missile itself can be used for precision strikes on enemy tactical targets such as checkpoints, bridges, depots, troop concentrations and airfields. The fragmentation warhead can be replaced with a nuclear, biological or chemical warhead. The solid propellant makes the missile easy to maintain and deploy.

OTR-21 units are usually managed in a brigade structure. There are 18 launchers in a brigade. Each launcher is equipped with two or three rockets.

The vehicle is amphibious with a maximum speed of 60 km/h and 8 km/h in water. The vehicle is NBC protected. The system started to be developed in 1968. Three variants were developed.

Bayraktar TB2 aerial research/sweeping drone

As part of its military modernisation programme, the Armed Forces of Ukraine procured 12 Bayraktar TB2s in 2019. In January 2019, Baykar signed an agreement with Ukrspetsproject, part of Ukroboronprom, to purchase six TB2s and 3 ground control stations worth $69 million for the Ukrainian military.Ukraine received the first batch of UAVs in March 2019. After the successful testing of the aircraft, the Ukrainian Navy placed a separate order for six TB2s, they were delivered starting in 2021, according to Navy officials. Meanwhile, Turkish and Ukrainian officials announced the establishment of a joint venture to produce 48 additional Bayraktar TB2s in Ukraine.

During a Russian military buildup in Crimea and near Ukraine's borders, a TB2 conducted a reconnaissance flight over the Donbas region on 9 April 2021. This was the first operational use of the aircraft by Ukrainian forces in an active conflict zone. In October 2021, a TB2 drone was first used in combat during the war, targeting a Russian separatist artillery position, destroying a D-30 howitzer and stopping the shelling

of Ukrainian troops near Hranitne. Later, the BT2 was used over the sea for scouting, correcting fire and hitting small craft using Mini Akıllı Mühimmat (MAM) guided bombs.

Mini Akıllı Mühimmat (MAM)

It is a family of laser and/or GPS/INS guided bombs produced by Turkish manufacturer Roketsan.

MAM has been developed for unmanned aerial vehicles (UAVs), light attack aircraft, fighter jets and air-to-ground missions for low payload air platforms. The MAM can engage both stationary and moving targets with high accuracy.

Technical specifications	MAM-C	MAM-L	MAM-T
Diameter	70 mm	160 mm	230 mm
Length	970 mm	1 m	1.4 m
Weight	6.5 kg	22kg	94kg
Beat	8 kilometres	15 kilometres	30+ km (UCAV)60+ km (light attack aircraft)80+ km (fighter aircraft)
Search	Semi-active laser	Semi-active laser	Semi-active laser GPS/INS
Types of bulb	Multi-functional fire (blast fragmentation, incendiary and armour-piercing) Explosive explosion fragmentation	Tandem - effective against reactive armour Explosive explosion fragmentation Thermobaric	Explosive explosion fragmentation
Spotlights		Impact Close	
Platform	Unmanned aerial vehicles and light attack aircraft	Unmanned aerial vehicles and light attack aircraft	Unmanned aerial vehicles, light attack aircraft and combat aircraft
Basis	Roketsan Cirit	Roketsan L-UMTAS	Roketsan TRG-230
Manufacturer	Roketsan	Roketsan	Roketsan

Fig. 17 represents the Mini Akıllı Mühimmat (MAM) variant

1. The MAM-L IIR features an infrared seeker instead of an SAL seeker, an RF data link, an extended operational range of over 25 km and a slightly increased weight of 23 kg, while retaining the basic model's external appearance and warheads.

2. The MAM-T IIR has similar looking changes with an improved mid-body wing kit, increased weight by 100kg, a claimed maximum range of over 50km.

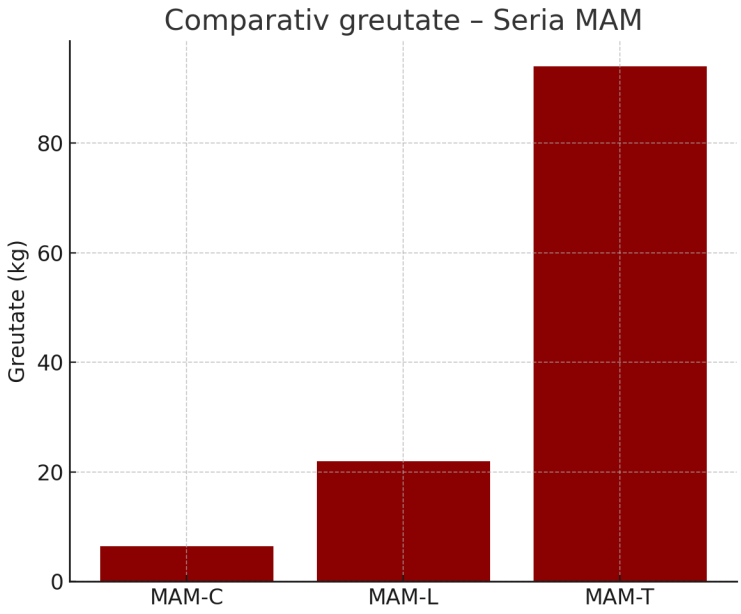

Fig. 18 represents the weight of the Mini Akıllı Mühimmat (MAM) variants

Sea mines

Contact mine R-421-75

The explosive power of this type of mine ranges from 80 to 160 kg of TNT equivalent. These mines can be used as drifting or anchored mines. Fitted with contact detonators, they explode on contact with anything strong enough to hit them.

Anchored mine type YaM or MYaM

A mine of this type weighs more than 150 kilograms, contains about 20 kilograms of TNT as an explosive charge and is equipped with a contact detonator. Storms or weak materials can tear these mines from their anchors, tethers or chains, causing them to drift with the current in an uncontrolled manner.

YaRM anchored mine

A mine of this type weighs 13 kilograms, contains about 3 kilograms of TNT as an explosive charge and is equipped with a contact detonator. These mines are used in shallow waters near riverbanks, lakeshores and coasts to counter landing craft and other amphibious vehicles.

In addition to these types of mines laid by Ukraine as part of its anti-desertification defences, there is also the danger of landmines from the landslides caused by the destruction of the Nova Kahovka dam in Ukraine.

Since Russia invaded Ukraine in February 2022, large parts of the Black Sea coast have been mined by the warring sides. In addition, a significant number of land and river mines (see "anchored mine type YaRM" in the information box above) have been swept away by floods, such as the one caused by the destruction of the Kachowka Dam in June 2023. Most of the mines are anchored YaM type mines, which contain 20kg of explosive material. This type of mine was developed during World War II and most of the

stockpiles date back to the Soviet Union. They are ageing weapons that can break free from their anchors and tethers in storms or due to material weakness; once free, they turn into deadly floating bombs ready to detonate on contact. The current carries the mines from the war zone in Romania and through Bulgaria to Turkey and the Bosphorus Strait. It is not possible to estimate how many naval mines have been laid and are currently floating. The potential danger from mines in the Black Sea is very high; the NATO Shipping Centre has repeatedly highlighted the dangers arising from these drifting time bombs.

Since the outbreak of war, the shipping industry has stepped up its security measures and local port authorities in Romania, Bulgaria and Turkey provide daily updates on the situation. In November 2023, insurance companies responded by increasing war risk insurance premiums to 3% of a ship's value. These premiums are typically well below 0.1 per cent.10 In other crisis regions, such as the Red Sea, ships have to pay between 0.5 and 0.7 per cent of their value as additional war risk premium.

The naval forces of NATO Black Sea countries conduct regular de-mining patrols in the Black Sea. In 2023, Romania also acquired two demining vessels from the British Navy. In January 2024, Bulgaria, Romania and Turkey agreed to work together to tackle the threat posed by naval mines in the Black Sea. They committed to coordinate their efforts to detect and destroy these sea mines.

Romania as well as insurance companies advise all ships to navigate with extreme caution, closely monitoring the water surface by setting up dedicated observation posts on board. In practice, this means that a crew member should be assigned to continuously watch the water surface for drifting mines - one of the few measures that can help prevent contact with these floating explosive devices. All suspected sightings should be reported immediately.

Fig. 16 represents transport routes[52]

[52] https://substackcdn.com/image/fetch/f_auto,q_auto:good,fl_progressive:steep/https%3A%2F%2Fsubstack-post-media.s3.amazonaws.com%2Fpublic%2Fimages%2Fdce30b43-76c5-45f6-aa11-c004d797aac6_394x389.png

Minefields also pose a significant threat to Black Sea fisheries: fishermen report that mines have sunk to the seabed or drift just below the surface, where they can be caught in fishing gear. Several such incidents have occurred in Romania, Bulgaria and Turkey. Fishermen are urged to be extremely cautious as mines, depending on their type, can detonate with even minimal contact.

Marine drones are detailed in Annex 2

9. Lessons learnt and implications for Russian and global naval doctrine

The collapse of the Russian Black Sea Fleet offers valuable lessons for Russia and other naval powers. The conflict served as a veritable "laboratory" of modern naval warfare, testing the limits of traditional technologies and the effectiveness of emerging concepts. We will discuss, on the one hand, the lessons for Russian naval doctrine (what Russia should change in its maritime approach), and, on the other hand, the global lessons - how other states view these events and what adaptations they could make to their own naval strategies.

Using BT2 against Russian invasion in 2022

During the Russian invasion of Ukraine in 2022, TB2 drones were used by Ukraine's armed forces against Russian forces and equipment. In January, before the invasion, the spokesman of the air force command, Lieutenant-Colonel Yuri Ihnat, said that "Ukraine has about 20 Bayraktar drones, but we will not stop here". On 2 March, Ukrainian Defence Minister Oleksii Reznikov announced the arrival of additional TB2 drones. According to video footage released by the armed forces, TB2 drones have successfully destroyed a Russian command post, military vehicles - including tanks, IFVs and various types of trucks - surface-to-air missile systems (including Buk and Tor systems), self-propelled artillery, a multiple rocket launcher (MLRS), howitzers and an electronic warfare system on several occasions. The drone also destroyed two Russian fuel trains, patrol boats and a helicopter. On 24 February, the day of the invasion, four Bayraktar TB2 drones stationed at the Chuhuiv/Harkov airbase were abandoned and subsequently destroyed on the ground by Ukrainian forces amid reported Russian missile attacks. The Lugansk People's Militia of the Lugansk People's Republic claimed to have shot down two TB2 drones near Lugansk. On 27 February, the Ukrainian air force confirmed two TB2 strikes on Russian convoys in the Herson and Khytomyr regions. The head of the Ukrainian air force, Lieutenant General Mykola Oleschuk, called the UAV system "life-giving". The drone's popularity in Ukraine led to a song, "Bayraktar", which praised the drone while insulting the Russian military and its invasion. Ukrainian drones appear to be equipped with anti-jamming antennas. They apparently use MAM-C and MAM-L laser-guided bombs. Traditional search radars appear to struggle against the TB2

because of its low speed and small size, which gives it a small radar cross section. One radar that was destroyed on 7 May appeared to be actively scanning just before it was hit, although Russian units are turning off their own radars to reduce radar detection and targeting.

The drone can also be deployed in minutes and launched from a normal road. On 26 February 2022, two TB2 drones were shot down near Shchastia. On 17 March 2022, a TB2 Bayraktar TB2 was shot down over Kiev; Russia published images of the drone wreckage. A second TB2 drone was shot down on 29 March 2022 in eastern Ukraine. On 2 April, a third TB-2 drone was shot down. On 12 April 2022, a TB2 Bayraktar TB2 was reportedly shot down by the Russian frigate Admiral Essen off the coast of Crimea. On 13 April 2022, Ukrainian sources claimed that at least two R-360 Neptune missiles were responsible for sinking the Russian cruiser Moskva - causing an explosion on one of the exposed missile tubes on the deck of the ship. The drones, probably TB2s, were blamed for helping to decoy the cruiser's defences.

On 26 and 27 April, three other TB2 drones were destroyed, two in the Kursk region and the third in the Belgorod region, Russia, by a Pantsir-S1. On 1 May, a TB2 drone with registration S51T was shot down in the Kursk region, Russia. TB2 losses totalled seven units visually confirmed. On 2 May, Ukrainian-operated Bayraktar drones attacked and destroyed two Russian Raptor-class patrol boats near Snake Island. On 7 May, a TB2 drone attacked and destroyed a Russian Mil Mi-8 transport helicopter while offloading passengers on Snake Island. In the same deployment, a TB2 drone destroyed a Tor missile launcher on the island, while a second launcher was destroyed while being unloaded from a landing ship. This this paved the way for a bombing raid by a Sukhoi Su-27 "Flanker" aircraft of the Ukrainian Air Force against buildings on the island. On 23 May 2022, the wreckage of a Ukrainian Bayraktar TB2 TB2, tail number 75, was found in Romanian territorial waters by Romanian authorities. The drone was probably shot down during the attacks on Snake Island on 7 May.

On 28 May 2022, Lithuanian citizens raised $3.2 million, out of a unit cost of $5.37 million, to buy a single Bayraktar TB2 drone for Ukraine. On 2 June, Baykar said: 'The Lithuanian people have raised honourable funds to buy a Bayraktar TB2 for Ukraine. After learning this, Baykar will give a free Bayraktar TB2 to Lithuania and ask that these funds go to Ukraine for humanitarian aid." From the beginning of the invasion until the end of June, Ukraine received over 50 TB2s. On 28 June, Defence Minister Reznikov announced that Baykar would dedicate its full capabilities to meet the needs of the Ukrainian armed forces, fulfilling its requirement for "dozens more" aircraft. In July 2022, Haluk Bayraktar, CEO of Baykar, said in an interview that his company would never supply drones to Russia, as it supports Ukrainian sovereignty and independence.

Tactical lessons from the use of Bayraktar TB2 drones in the Black Sea area

The Russian-Ukrainian war demonstrated the strategic potential of naval and aerial drones in maritime theatres. Ukraine made extensive use of Bayraktar TB2 systems to counter Russian conventional superiority

and inflict significant damage on the Russian Federation's naval infrastructure, logistics and maritime mobility.

Since the start of the invasion in February 2022, TB2 drones have been used to destroy or disrupt critical Russian equipment including tanks, armoured vehicles, surface-to-air missile systems (Buk and Tor), self-propelled howitzers, patrol boats and even Mil Mi-8 helicopters during landing operations on Snake Island. Moreover, these drones were also indirectly involved in the sinking of the cruiser Moskva, contributing to the distraction and saturation of the ship's defences .[53]

Although several TB2 drones have been shot down in the Kharkiv, Lugansk, Kursk theatres or in the vicinity of Snake Island, the resilience of the systems and their ease of deployment have meant that Ukraine has been able to quickly replace lost units, including through successive deliveries from Baykar. By the end of June 2022, over 50 TB2s had been received by Ukraine .[54]

Drones have also proved effective against naval platforms. On 2 May and 7 May 2022, TB2s destroyed Russian Raptor speedboats and Tor launchers on Snake Island, creating an operational window for Ukrainian aircraft to strike Russian targets on the island. In addition, features such as low radar cross-section and being equipped with MAM-C/MAM-L smart munitions allowed them to operate relatively undetected in contested spaces.

This experience shows that the Romanian Naval Forces should develop an autonomous air and naval flotilla, with similar capabilities, integrable into NATO ISR and C4ISR systems, but also capable of operating in A2/AD scenarios in the vicinity of contested areas (such as the extended Exclusive Economic Zone or the Snake Island).

Further use and vulnerability

Although at the beginning of the invasion Ukrainian drones, including the TB2, could be used to harass Russian forces, by the summer of 2022 they had become less effective in this role. The Russians, initially disorganised, were late in establishing adequate air defences, but once they did so, Ukrainian UAVs were shot down with increasing frequency. In addition to direct shoot downs, Russia has made extensive use of electronic warfare (EW) to jam and disrupt drone communications, prompting the Ukrainians to reduce their use of TB2. At the end of July 2022, a military expert explained that the low speed and average altitude of Bayraktar TB2 drones made them easy targets for Russian anti-aircraft defences, many of which have already been shot down.[55]

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[53] Bronk, Justin. "How Ukraine Used Bayraktar Drones to Distract the Moskva." Royal United Services Institute (RUSI), April 2022.

[54] "Ukraine Destroys Russian Raptor Boats and SAM Systems with Bayraktar TB2." Naval News, May 2022.

[55] Janovsky, Jakub, naalsio26, Aloha, Dan and Kemal. "Attack on Europe: Documenting Ukrainian Equipment Losses During the Russian Invasion of Ukraine." *Oryx*, 24 February 2022. Accessed 5 April 2025. https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-ukrainian.html. https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-ukrainian.html.

At the end of July 2022, a TB2 drone with the number U139 was shot down in the Belgorod region of Russia. On 2 August, another drone, designator 409, was destroyed in Ukraine, followed by the discovery of the remains of a TB2 drone in Herson on 2 September[56] . By July 2022, visually confirmed losses of Bayraktar TB2 drones totalled 14 units .[57]

On 15 January 2023, another Bayraktar TB2 was shot down using exclusively Russian electronic warfare systems. Later, on 22 January 2023, the remains of another destroyed TB2 drone were found in the Odessa region. The commander of the Russian Air Defence Forces, Lieutenant General Andrei Demin, claimed in April 2023 that Russia had shot down more than 100 Bayraktar drones since the beginning of the conflict.

On 23 February 2023, a Bayraktar TB2 crashed in the Kharkiv region due to a friendly fire incident. On 5 May 2023, the Ukrainian Air Force admitted to shooting down one of its own TB2 drones over Kiev after losing control of it, possibly due to a technical malfunction. There were no casualties. Later, on 12 May 2023, another TB2 drone was shot down by Russian forces near Marinka.

By June 2023, the role of the TB2 drones had changed significantly from direct attack to predominantly reconnaissance missions, staying out of range of Russian air defence systems and using advanced optical sensors to direct fire at other units and drones[58] . On 17 July 2023, another TB2 drone, designator T263, was shot down in the Herson region.

On 3 September 2023, Ukraine published footage of the destruction of a KS-701 patrol boat by a TB2 drone. This was the first confirmed confirmed offensive use of a TB2 drone after a long period of inactivity in direct attack missions. It is believed that the weakening of Russian air defences following Ukraine's constant attacks would have allowed the offensive use of TB2 drones again. However, Colonel Volodimir Valiukh, a commander in Ukraine's Main Intelligence Directorate, stated in October 2023 that TB2 drones are rarely and predominantly used in short reconnaissance missions due to the ongoing threats posed by Russia's sophisticated air defences and advanced electronic warfare systems, explicitly stating that "it is hard to find situations in which to use them"[59]

According to data compiled by Oryx Blog, as of 25 February 2025, 26 Bayraktar TB2 drones have been visually confirmed as destroyed, either shot down in flight or neutralised on the ground by Russian forces .[60]

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[56] *Ibid.*

[57] *Ibid.*

[58] *Ibid.*

[59] Ukraine's TB2 drones struggle for relevance amid improved Russian defences. Newsweek. "Why Ukraine's Once-Feared Bayraktar Drones Are Becoming Obsolete." *Newsweek*, 20 October 2023. Accessed 5 April 2025. https://www.newsweek.com/ukraine-bayraktar-tb2-russia-1839972. https://www.newsweek.com/ukraine-bayraktar-tb2-russia-1839972.

[60] Oryx Blog, op. cit.

Lessons for Russian naval doctrine

Fig. 17 shows the Russian Black Sea Fleet, which lost a third of the warships it had at the start of the war in Ukraine. Photo: Profimedia Images[61]

Russia, heir to the Soviet Navy, had a naval doctrine that combined elements of littoral defence (anti-access) with *blue-water navy* ambitions (exemplified by the Northern Fleet). The Black Sea Fleet was seen as the regional force of supremacy in a relatively closed theatre dominated by Russia. Events 2022-2025, however, revealed major shortcomings:

a) Underestimating the asymmetric enemy

Perhaps the most obvious lesson is that Russia underestimated its adversary. It relied on the idea that Ukraine, without ships, could not pose a serious threat at sea. This inverted[62] "sea blindness" (deaf blindness to threats ashore) has cost *Moskva* and others. Russian doctrine will have to seriously integrate the scenario in which an adversary without a conventional fleet can still deny access at sea by land-based means (coastal missiles, long-range artillery, drones). The Russians themselves had practised this concept (A2/AD based on coastal systems, such as their P-800 *Bastion* missile bastion in the Crimea), but found themselves in the opposite position.

b) Air defence for large ships

The sinking of the *Moskva* will be studied in naval academies (it is even said to be "a case to be studied in academies"[63]). It highlights multiple failures: from crew training (inability to respond effectively to the hit and put out the fire) to technical problems (possible failure of the main radar or absence of AWACS above). Russia will have to review how it equips its ships with sensors and close-in defence systems (CIWS). *Moskva*

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[61] https://www.digi24.ro/stiri/externe/ucraina-a-distrus-o-treime-din-navele-rusesti-din-marea-neagra-sunt-flotele-traditionale-de-domeniul-trecutului-time-2713299

[62] LaGrone, Sam. "Warship Moskva Moskva Was Blind to Ukrainian Missile Attack, Analysis Shows." *USNI News*, 5 May 2022. Accessed 5 April 2025. https://news.usni.org/2022/05/05/warship-moskva-was-blind-to-ukrainian-missile-attack-analysis-shows.
https://news.usni.org/2022/05/05/warship-moskva-was-blind-to-ukrainian-missile-attack-analysis-shows.

[63] Zimm, Alan D. "Antiship Missile Lessons from Sinking of the Moskva." *Proceedings* 148, no. 5 (May 2022). Accessed 5 April 2025. https://www.usni.org/magazines/proceedings/2022/may/antiship-missile-lessons-sinking-moskva.
https://www.usni.org/magazines/proceedings/2022/may/antiship-missile-lessons-sinking-moskva.

did not have a modern CIWS (only old AK-630 guns), and its short-range anti-aircraft missiles OSA were outdated. Had it had a modern *Kashtan* or *Pantsir-M* type system, perhaps the fate might have been different. It will also emphasise integrating data from other sources (satellite, coastal radar) directly to the ships - maybe *Moskva* didn't get the alert in time. The Russians could accelerate their own drone projects to provide maritime surveillance, so as not to depend on expensive piloted aircraft.

c) Doctrine of Dispersion vs. Concentration

Typically, Russia deploys ships in fairly small groups (the Black Sea Fleet doesn't have aircraft carriers or escort destroyers like the US Navy). With one powerful flagship and the rest smaller, the formula was vulnerable to decapitation. The lesson is that *Moskva* operated alone relatively close to the coast - too close for safety. Perhaps doctrine will stipulate not to get so close without complete coastal clearance. Besides, the Russians reacted by moving the fleet, so they adopted geographic *dispersion* as a defensive tactic (a concept contrary to offensive doctrine). In the future, they could plan redundant port infrastructure (more ports capable of accommodating large ships, as they were exploring with Abkhazia - *Oceamcire* - while inappropriate, it's a signal).

d) The need for defence against naval drones

An entirely new element for the Russians is how to defend against *swarms of USVs*. The Soviets didn't encounter this, so they had no dedicated doctrinal chapters. Now, it is clear that every military harbour must be protected not only against classic submarines and mines, but also against these fast drones. We are likely to see investment in acoustic sensors in harbours, perhaps electrified nets or some kind of "small deterrent" - for example, they could experiment with high-powered *microwave weapons* that fry the electronics of nearby drones, or with anti-drone drones (a kind of drone-robot interceptor). It's a new area of weaponry: anti-USV warfare. The Russians, like others, now have the motivation to develop it.

e) Rethinking the surface vs sub-surface fleet balance

Kilo submarines were the hardest to reach platforms for Ukraine until they hit dry dock with Storm Shadow. Some Russian analysts might conclude that submarines are the safer investment than corvettes/ frigates that have been decimated. It is possible that, doctrinally, the Russian Navy will further emphasise submarines (they were already the pride of the Northern Fleet). In future plans, the Russian surface fleet (cruisers, destroyers) was suffering from lack of resources and sanctions anyway (can't build big engines due to embargo). Thus, Russia is likely to *scale down ambitions for large surface fleets* and emphasise:

i. Conventional missile submarines (Kilo class and future Lada).
ii. Multirole nuclear submarines (Yasen) capable of launching hypersonic anti-ship missiles (Zircon).
iii. Coastal mobile missile platforms (Bastion, Bal) - already used to threaten NATO ships, e.g. the Russians fired Bastion in December 2022 on a civilian tugboat as a demonstration.

f) Improving naval aviation and integrating air and naval forces

After the ships withdrew, naval aviation took over combat roles. Russian doctrine emphasised the importance of naval aviation, but the Black Sea Fleet did not have an aircraft carrier and relied on the air

force's (VKS) aviation in Crimea. One lesson is the need for better synergy between aviation and fleet. For example, to counter the attack on *Ivanovets*, the Russians would have needed helicopters in the air, ready to fire. Maybe they didn't react fast enough. From now on, it's likely that any Russian ship going to sea will be accompanied by a patrol plane or helicopter. Russia could invest in surface aerial drones (helicopter type) that take off from ships, patrol radially and land - as an anti-USV safety cordon. The Russians will also emphasise *"deny NATO ISR*" - i.e. how to prevent NATO from spying on their ships. They have already brought a special (jamming) ship to Sevastopol and are experimenting with signal jamming (such as smoke curtain and GPS spoofing[64] around Crimea).

g) The human and moral element. The painful lesson is conferred by the morale of the crews.

After so many losses, the Russians will have to renew the sailors' confidence. The training doctrine is likely to emphasise reaction to damage and combat discipline (there have been criticisms that the *Moskva* crew reacted slowly, many of them inexperienced youngsters). Rigorous *damage control-type* training will likely follow, inspired by American sailors who have a tradition of fighting for the ship's survival. Russian commanders will also be less willing to take risks. One effect already seen: the Russians were very cautious after April 2022, not sailing near Odessa at all. This *"culture of caution"* will remain, which is a notable change (traditionally, the Russian Navy valued heroism and aggression, the motto of the Northern Fleet was "First to Attack").

h) Review planning in regional conflicts

Specifically, it is clear that any future Russian plan to attack a littoral state (be it Ukraine or any other) will have to seriously consider neutralising coastal threats beforehand. Russia failed to destroy the Neptun batteries in time or to secure the Odessa - Mykolaiv coastline. If they had occupied Odessa quickly, the maritime scenario would have been completely different (Ukraine would have had nowhere to deploy Harpoon/Neptun directly to the sea). Now, the Russians know that *timing* is crucial: let the enemy harden its shore, and your fleet becomes the target. For Russian doctrine, the war in Ukraine will impose:

i) More focus on coastal warfare: how to defend your fleet from shore attacks.

j) Integration of new defence technologies: anti-drone, smart anti-mine.

k) Realism about the role of the fleet: recognise that the fleet needs to be used in a calibrated way, otherwise it risks rapid losses (possibly less bluster with parades and "bulging muscles" - incidentally, in 2023 Putin held the Navy Parade in St Petersburg, far away from Crimea).

l) As a doctrinal innovation, the Russians will carefully study Ukrainian tactics. Ironically, the Russians have historically excelled at asymmetric warfare, but here they have been its victims. They can be expected to adapt and possibly copy: for example, they could develop their own naval drones (there are already reports that they are testing such in the Arctic), which they could use in the future (perhaps not in this current conflict, but the concept will be adopted).

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[64] Spoofing

Global lessons and international implications

It's not just Russia that is learning from this campaign, but the rest of the world - especially the big naval powers like the US, China, the UK, but also smaller countries looking for ways to defend themselves against superior fleets.

For NATO and the US:

a) Confirming the effectiveness of *Distributed Lethality* and *A2/AD*: NATO has always viewed with concern Russian *A2/AD bubbles* (e.g. Kaliningrad, Crimea, Syria) designed to keep allied fleets at bay. Paradoxically, Ukraine has created an improvised A2/AD 'bubble' with mobile systems and has shattered the Russian fleet locally. This confirms that an adversary can deny access to a modern fleet with relatively cheap means. NATO will be studying how the Ukrainians have done it, to apply in their own defence plans: for example, the Baltic countries could draw conclusions about coastal defences against the Russian Baltic Fleet. Poland is buying coastal missiles; Romania has expressed interest in anti-ship systems (buying Norwegian NSMs). Ukraine's success lends credibility to these investments.

b) The need for countermeasures against their own vulnerabilities. The NATO fleets (aircraft carriers, destroyers) are much better equipped anti-aircraft than the Russian, but still vulnerable to drone swarms. The US Navy is already experimenting with LASERs and targeted anti-drone weapons; these programmes will gain momentum, with a real-life example of what can happen if a swarm saturates a naval group. NATO will also be watching the development of underwater drones - the Russians haven't used them (apart from maybe mines), but there are fears that autonomous submarines could hunt aircraft carriers in the future.

c) Confirmation of the importance of intelligence and information superiority as the US and NATO have been testing their ISR (Intelligence, Surveillance, Reconnaissance) capabilities in support of Ukraine without being belligerent. The results (e.g. surgical strikes in Sevastopol) show the strength of the Western sensor network. For the West, it is an argument to continue the development of integrated data networks between allies, because they have a force multiplier effect on friendly forces. One analyst notes: "Western navies should take note to learn from Russia's shortcomings and Ukraine's successes"[65] .[66]

For China and other naval powers:

a) China, with its maritime ambitions (control of the South China M., possibly an invasion of Taiwan), probably watched the conflict closely. The situation is not identical (China has a much larger fleet and

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[65] Huminski, Joshua C. "Learning the Right Lessons from Ukraine's Naval War." *Engelsberg Ideas*, 6 June 2024. Accessed 5 April 2025. https://engelsbergideas.com/notebook/learning-the-right-lessons-from-ukraines-naval-war/. https://engelsbergideas.com/notebook/learning-the-right-lessons-from-ukraines-naval-war/.

[66] Western naval forces should take note to learn from Russia's shortcomings and Ukraine's successes

would have local air superiority in the Taiwan Strait if it attacked), but the lesson of drones and missiles is relevant: Taiwan could use swarms of USVs or mobile missiles to make a landing costly. China is already investing heavily in surface drones (a Chinese *JARI* drone that resembles Sea Baby in concept has been publicised). Also, the sinking of the *Moskva* is sending shivers down the spine of any fleet operator: the Chinese are asking: our aircraft carriers Liaoning and Shandong, how vulnerable are they to saturated anti-ship missiles? So they will concentrate on defences: more escort ships, integrated anti-missile system (even a mini-"Iron Dome" marine).

b) States with small fleets, but threatened by larger fleets (e.g. Gulf countries vs Iran, South Korea vs North Korea or vs China) will see in the Ukrainian example a confirmation of the *"porcupine*" strategy - the hedgehog: don't compete directly, but make it painful for anyone who comes close. Purchases of coastal missiles, drones, smart mines will increase. Military industries can be expected to develop on-demand offerings: e.g. Turkey is already promoting a kamikaze USV called the *MARLIN* inspired by the naval Bayraktar. Israel, known for its technology, will probably produce naval anti-drone systems and perhaps its own USVs.

c) **Legal and ethical impact**

The use of naval drones has raised questions of international law (is an unmanned USV considered a warship? Can it be captured? What status do the crews operating them have?). These grey areas will require clarification in maritime conventions. Already, after the Novorossiysk attack, the Russians have labelled drone operators as "terrorists" in an attempt to delegitimise them - an argument rejected by Kiev, which says they were legitimate military targets . The international community will have to set the rules (just like the aerial drone discussions).

d) **Redefining maritime superiority.**

As a general lesson: superiority is no longer just about tonnage and number of ships. An American admiral recently wrote that *"the age of the large surface combatant might be waning*"[67] . This conflict seems to support it. Fleets can think of more small, modular, dispersed platforms - hard to eliminate all at once - rather than few large ones. This is already a trend, but events are accelerating it. For example, the US Navy is testing the *Ghost Fleet* concept - a flotilla of small autonomous ships. Conceptually, the Russian Navy could think similarly for the Black Sea: instead of another cruiser (they can't afford them anyway), have a swarm of 20 missile-armed USVs to supplement.

e) **Strengthening the Montreux Convention**

Turkey used its Montreux prerogatives immediately (Feb 2022) to limit escalation[68] . It was an example of responsible application of maritime law. Presumably the international community will maintain the

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[67] "the age of the big surface combatant may be in decline"

[68] In February 2022, Turkey invoked the provisions of the 1936 Montreux Convention to limit the escalation of conflict in the Black Sea region. This convention regulates the transit of ships through the Bosphorus and Dardanelles Straits, allowing Turkey to restrict access of warships of belligerent states during wartime. On 27 February 2022, Turkish Foreign Minister Mevlüt Çavuşoğlu officially recognised the conflict between

convention as a pillar of stability - if the straits were open, the conflict could have escalated a lot (Russia would have brought more ships, NATO may have reacted). Future discussions on Montreux will take into account the lessons of the war: for example, an amendment could call for closer international consultations in such situations.

f) **For Ukraine itself:**

Its successes have shown that investing in military creativity pays off. In the absence of a conventional fleet, Ukraine has virtually created a **"silicon and explosives fleet"**. After the war, Ukraine might not have the resources to build large corvettes or frigates, but it could standardise drone fleets as an element of coastal defence. Maybe we will see in Ukraine the 6th drone fleet... It is plausible that a hybrid model will emerge: a few large ships (for NATO flag and cooperation) plus an asymmetric arsenal (for deterring Russia). A bitter lesson for Ukraine, however, is that *it could not completely eliminate the Kalibr missile threat*. Even with the Russian fleet suffering, the submarines continued the chain of strikes on Ukrainian infrastructure. Going forward, Ukraine will probably want better anti-submarine capabilities (perhaps fixed sonars, patrol planes, helicopters) to counter the latter threat as well.

Russia and Ukraine as a "war", thus activating the relevant provisions of the convention. Subsequently, Turkey closed the straits to warships of the states involved in the conflict, allowing only their return to their home bases.

10. Lessons learned applicable to the Romanian Naval Forces: strategic perspectives and needs for modernisation and equipment

"The ultimate goal of maritime power
is to ensure freedom of action at sea
and deny the same freedom to the enemy."
Sir Julian Corbett - British historian and naval strategist

NOTE

This chapter reflects the author's own analysis of some of the lessons identified as well as proposals applicable to the Romanian Naval Forces. Certainly the RNF have their own analysis and have clearly set out the directions regarding the equipping and perspective plans which may not coincide with our judgements.

The conflict in Ukraine and the aggressive expansion of the Russian military presence in the Black Sea basin have reconfigured maritime security paradigms in NATO's eastern flank. In this context, the Romanian Naval Forces (FNR) are called to adopt an adaptive strategic path, based on the operational lessons learnt from the Russian-Ukrainian conflict. Learning from recent mistakes and successes becomes essential to calibrate the structural and operational efficiency of the FNR in relation to the new regional strategic requirements.

The analysis of the degradation of Russia's naval capabilities in the period 2022-2025 and the assessment of the impact of these developments on Romania's maritime defence posture converge towards several fundamental conclusions. First, the nature of maritime warfare has radically transformed, going beyond the paradigm of symmetric confrontations in favour of a hybrid reality, characterised by operational autonomy, extended mobility, advanced networking and doctrinal adaptability. Secondly, Russia's inability to protect its naval infrastructure, anticipate asymmetric threats and integrate complex platforms into modern C2 (*command and control*) architectures is a warning to any littoral state with naval aspirations in the region.

For Romania, the lessons are clear: maritime survival and efficiency in the 21st century will not depend on tonnage or numbers, but on the quality of interoperability, the ability to anticipate and the degree of systemic resilience. The FNR (Romanian Naval Forces) must become a compact, agile and intelligent force, capable of integrating both national capabilities and the strategic and technological networks of NATO and the European Union.

Lessons learnt from the regional and allied context

Vulnerability of critical maritime infrastructure

The attacks by Russian forces on Ukrainian ports, in particular Odessa and Chornomorsk, have clearly demonstrated the vulnerability of the logistical and energy infrastructure in the maritime space. This lesson is directly applicable to Romania, which must invest as a matter of priority in air defence and anti-drone capabilities to protect the ports of Constanța, Mangalia and Midia and the ports on the Danube. The protection of dual-use infrastructure in times of conflict becomes an essential element of national resilience.

The importance of integrated maritime surveillance

NATO-coordinated ISR (Intelligence, Surveillance, Reconnaissance) operations in the Black Sea have emphasised the value of data fusion between land, air, sea and space platforms. For the Romanian Naval Forces, a strategic priority is the full integration of their own platforms into the allied C4ISR network to enable early warning, real-time decision making and information support in modern naval combat.

The relevance of asymmetric capabilities and tactical mobility

Russia has demonstrated an increased level of tactical adaptability, effectively utilising naval and aerial drones, smart sea mines and mobile coastal strike systems. These asymmetric, hard-to-predict and cost-effective tools can disrupt conventional operations. The NRF must adapt its doctrine to include a fleet of fast, modular, low radar footprint naval assets capable of operating in a decentralised regime and in contested environments.

Civil-military co-operation in the maritime context

The Norwegian, Polish and British models have emphasised that maritime resilience cannot be achieved by military means alone. Joint civil-military planning is needed, especially in protecting critical infrastructure and maritime logistics chains. In Romania, co-operation between the Romanian Navy, ARSVOM, the Administration of Sea Ports and the Department for Emergency Situations (DSU) needs to be strengthened through joint simulations, exercises and operational protocols.

Operational lessons from the Black Sea theatre and implications for Romania

Purchase of modern multifunctional platforms

The transformation of the Romanian Naval Forces into a relevant actor in the Black Sea region requires adapting to new naval warfare paradigms, as tested and validated (or disproved) in the Russian-Ukrainian conflict. Russia's invasion of Ukraine has highlighted traditional naval vulnerabilities and accelerated the transition to a distributed, asymmetric and smart-network-based maritime doctrine.

New-generation multifunctional corvettes

a) The Ukrainian experience has shown that large, slow and poorly defended naval platforms (such as the *Moskva*) become easy targets in the absence of a modern air and drone defence system. The battleships of the future must include:

- Integrated air, missile and artillery defence systems (e.g. MICA VL, RAM, close defence artillery systems);
- multi-spectrum sensors (EO/IR, AESA radar, LPI);
- active electromagnetic defence (ECM, decoy launchers).

Key lesson: *Survivability depends on early detection, mobility and autonomous layered defence*.

Submarines and deep-sea deterrence

b) Russia, in the absence of Ukraine's anti-submarine warfare capabilities (ships or helicopters) has effectively utilised its *Kilo-class* submarines to launch Kalibr missiles against land targets. However, their lack of tactical mobility and the absence of sonar dominance in the Black Sea limited their operational effectiveness.

Romania can exploit this strategic vacuum by acquiring an AIP submarine (Scorpène class[69] /212CD) or other type with capabilities:

- Advanced Underwater ISR;
- Launching submersible attack and research drones (UUV);
- launching missiles from immersion;
- support for special forces and clandestine operations.

Key lesson: *submarines are no longer just attack platforms, but underwater nodes of strategic networking*.

Autonomous aerial and naval drones

c) Ukraine has managed to destabilise Russian naval dominance off Crimea with improvised, remote-controlled naval drones and UAVs equipped with reconnaissance and strike systems. For Romania, this model confirms the need for:

- *USV* (naval surface UAV) flotilla with sensors and modular payload;
- Marine *UAV* with extended autonomy and closed-loop AI for immediate response to threats;
-capable vessels for aerial, naval surface or submarine drone operations
- portable C2 platforms for distributed control of these drones.

Key lesson: *speed, dispersion and artificial intelligence compensate for numerical inferiority*.

OPVs and dual-capable patrol vessels

[69] Discussions about this possible solution have been mediatised.

d) Ukraine's maritime surveillance and control operations have been facilitated by fast, easy-to-maintain platforms capable of operating in highly contested environments. Romania needs to acquire modern OPVs:

- with lightweight drone and helicopter decks;
- capable of multiple refuelling (for sustained operations);
-capable of integrating into regionally constituted naval groups of EU, NATO or Partnership for Peace vessels;
- interoperable with NATO maritime patrol systems.

Key lesson: *permanent naval presence is not just about power, it is complemented by relevant and resilient presence*.

Reconfiguring frigates and digitising the existing fleet

e) Romania's *Type 22* frigates urgently need to be upgraded to cope with the new generation of threats. A lesson from the conflict: analogue platforms, not integrated in C4ISR networks and without drone protection, are obsolete in the first wave.

Recommendations:

- Integration of LPI radar and ESM sensors for electromagnetic spectrum;
- Implementation of modern CIWS (e.g. SeaRAM);
- Real-time connection to the NATO C2 network.

Key lesson: *modernisation in the absence of connectivity does not provide superiority, only temporary survival*.

Mine warfare and mine counter-mining capabilities

f) Smart mines placed by Russia have blocked harbours, shipping channels and trade routes. Romania needs to create a specialised mine warfare component:

- mine-hunting vessels equipped with autonomous underwater drones;
- Marine LIDAR sonar sensors and magnetic detection systems;
- rapid intervention capability in critical harbour areas;
-developing/procurement of own smart mines and the ships and air assets to launch them.

Key lesson: *sea mines are low-cost, high-impact strategic weapons that require dedicated, not improvised responses*.

Final recommendations on the purchase of OPVs

The Romanian Naval Forces (FNR) are facing the need to rapidly adapt their own capabilities, and the acquisition of Offshore Patrol Vessel (OPV) platforms is an urgent and unavoidable strategic priority, also due to the fact that the acquisition of multirole corvettes is on the horizon.

In this context, MVNOs are an essential doctrinal element capable of ensuring:

- Permanent naval presence along the entire length of the national coastline;

- Surveillance and control of territorial waters and Exclusive Economic Zone (EEZ) ;[70]
- Rapid reaction capability in maritime law enforcement, drone neutralisation, escort and critical infrastructure protection.

OPVs allow for variable armament and configuration, adaptable to diverse missions - from patrolling, search and rescue, anti-smuggling, rapid intervention or low-intensity military action[71] . Compared to large platforms (frigates or corvettes), OPVs have low operating costs and increased logistical autonomy, ensuring the deployment of long-duration missions in the Black Sea environment. The characteristics of contemporary naval conflict - the proliferation of surface and underwater drones, smart mines, fast attack vessels - require agile, resilient platforms equipped with modern sensors and rapid response capabilities. The emergence of risks in the Danube Delta, the Snake Island area and in the vicinity of offshore infrastructure clearly justifies the need for OPVs[72]

The integration of OPVs would directly address the current challenges in the Black Sea area:

Operational area	Strategic function OPV
The Danube Delta and its own coastline	Surveillance, rapid response, river-sea control
Offshore Exclusive Economic Zone	Protection of energy resources, escort, continuous naval presence
Snake Island and surroundings	Deterrence, maritime traffic control, combating hybrid activities

Recent examples from NATO and EU littoral states confirm the trend towards the integration of OPVs as a central element of eastern flank naval strategies. Italy, France, Poland or Turkey have already adapted their naval strategies by integrating OPVs into their naval force structures[73]

The lack of VPOs in the structure of the FNR risks to make Romanian maritime control vulnerable and increase dependence on external partners and would expose the Romanian state to the following vulnerabilities :[74]

- inability to permanently monitor the EEZ;
- Overloading frigates/corvettes on routine missions;
- Increased vulnerability to asymmetric and hybrid actions;
- excessive dependence on NATO partners for the protection of its own maritime infrastructure.

The urgent procurement of a minimum of 4-6 modern OPVs for the Romanian Naval Forces is an irreplaceable strategic investment, justified by the operational realities in the Black Sea post-2022, NATO doctrinal standards and the need to protect Romania's economic and security interests in an increasingly contested and unstable maritime environment .[75]

[70]NAT Defence College, 'Strategic Adaptation in the Black Sea Basin', Research Paper No. 218, 2024.

[71] RAND Corporation, 'The Future of Naval Warfare: Autonomy, AI, and Asymmetry', Santa Monica, 2022.

[72] The emergence of risks in the Danube Delta, the Snake Island area and in the vicinity of offshore infrastructure clearly justifies the need for OPVs

[73] Naval News, 'OPV Programmes in Europe: Trends and Perspectives', 2023.

[74] Centre for European Policy Analysis, 'Black Sea Security after Ukraine War', 2024.

[75] Institut Français des Relations Internationales, 'European Naval Strategies in a New Era', 2023.

Naval infrastructure and logistics

Modernisation of military shipyards and conversion of Mangalia and Constanța Sud ports into dual-use infrastructure

Naval industrial capacity is a determining factor in underpinning strategic autonomy and regional military resilience. In this respect, the modernisation of military shipyards in Romania - especially in Mangalia - must be linked to the conversion of the ports of Constanța Sud and Mangalia into dual-use infrastructures capable of serving both commercial and collective defence needs.

This kind of conversion involves:

a) Digitalisation of naval production chains, integration of advanced technologies for the construction and maintenance of combat and logistic support ships;
b) Adaptation of port infrastructure to NATO operational requirements (e.g. depths for large tonnage ships, militarised logistic terminals, fast refuelling and repair points);
c) Establishment of rapid storage and mobilisation facilities for military equipment in the vicinity of ports, with immediate regional projection capability;
d) Cyber and physical security of ports, including through public-private partnerships with relevant EU maritime operators.

These investments would transform Romania's south-eastern area into a strategic hub for allied naval support in the Black Sea, with the potential to replicate the model in other areas of NATO interest.

Implementation of a NATO integrated logistics hub in the Dobrogea area

The Dobrogea area - with its port, road and rail infrastructure, as well as its proximity to the Allied Eastern Front - is the ideal place for a NATO integrated logistics hub, designed for the rapid mobilisation of forces and resources in the context of crises in the Pontic and wider MENA (Middle East and North Africa) area.

Functions:

a) **Strategic redistribution node** for equipment and troops, connected to European military corridors (e.g. Rhine-Danube Corridor);
b) **Integrated logistics command point**, interoperable with multinational structures deployed in Romania (e.g. NATO Force Integration Unit, Multinational Division South-East);
c) **Real-time support coordination centre** equipped with digital and AI infrastructure for supply chain management in operational theatres;
d) **Platform for multinational logistical exercises**, included in the NATO annual calendar.

The Hub would strengthen Romania's role in NATO's logistical build-up and would directly contribute to increased **force projection and deterrence** capabilities in the Black Sea region.

Strengthening electronic warfare (EW) and naval cyber defence capabilities

The Russian-Ukrainian conflict has brought to the fore an essential strategic truth: technological superiority is useless without protection of the electromagnetic spectrum and critical digital networks. In the Black Sea theatre, Russia has aggressively and effectively used jamming systems (*Krasukha-4*, *Murmansk-BN*, *Tirada-2S*) and targeted cyber attacks to annihilate tactical communications, induce glitches in adversary GPS systems, and block data transmission between ISR platforms and fire units.

Key lessons from the conflict:

a) Ukrainian drones (aerial and naval) have been neutralised on several occasions by Russian EM jamming, especially near Crimea.
b) Naval platforms equipped with C4ISR have become vulnerable in the absence of encryption and communications redundancy.
c) In the absence of a naval cyber ecosystem, port and logistics infrastructure has been subject to cyber-attacks causing operational delays and loss of critical data.

For Romania, the implications are clear:

Development of an integrated EW architecture for the Romanian Naval Forces:

Equip main ships (corvettes, frigates) with active jamming equipment and naval and airborne target imitation systems (DRFM, GNSS spoofing, directed ECM);
- Installation of *R-ESM/ELINT* systems for early detection of enemy EM sources;
- Training crews in combat scenarios in GPS-denied environments.

Naval Cyber Defence (CyberDef-Maritime):

Implementation of a *Maritime Cyber Operations Cell* within the FNR, in collaboration with the Cyber Defence Command of MApN;
- Cyber hardening of command and control (C2) systems, armaments and on-board sensors;
- Introduction of naval environment specific *Red Teaming Exercises* within NATO joint exercises (e.g. Cyber Coalition, Locked Shields, Sea Shield, Opex Edt);[76]
- Creation of a national alert and response protocol in case of cyber attack on Romanian harbours and AIS/navtex systems.

Multinational co-operation:

Interoperability between the EW/Cyber capabilities of the FNR and those of the naval forces of Poland, Turkey, Bulgaria and the UK;
- Participation in real-time data exchange and alert networks through NATO MARCOM and EU CyCLONe

[76] Experimenting new unmanned systems and technologies

;[77]

- Promotion of a regional *Maritime Cyber Resilience Hub* concept with proposed headquarters in Constanța, ensuring exchange of best practices, simulations and joint response to EM and cyber crises.

Doctrinal and institutional recommendations

Against the background of the new strategic realities generated by the Russian-Ukrainian conflict and the degradation of Russian maritime capabilities in the Black Sea, the doctrinal adaptation of the allied naval forces in the region is becoming a priority. Romania, as a neighbouring state and NATO member, must bring its structures and training into line with the new Western naval operational paradigms.

a. **Adoption of the Distributed Maritime Operations (DMO) concept**

The application of DMO involves the dispersion of naval forces along multiple operational axes while maintaining real-time tactical and information co-ordination. This model increases resilience against concentrated attacks and allows flexible force projection under hybrid warfare conditions. DMO is already adopted by the US Navy and adapted within NATO, and is an essential doctrine for fifth-generation maritime warfare.

b. Enhanced participation in relevant multinational exercises

Exercises such as Sea Breeze, Poseidon and BALTOPS provide an ideal operational framework for testing naval capabilities in complex scenarios, from electronic warfare and anti-submarine warfare to harbour security and maritime logistics. Romania should increase its participation and initiative in these formats, including by hosting specialised modules in the Black Sea area.

c. Founding a School of Hybrid Doctrine and Naval Innovation, an institution with proposed headquarters in Constanta and affiliated to an international academic-military consortium, would ensure:

- Develop doctrines adapted to the hybrid maritime environment (drones, cyber warfare, naval disinformation);
- Knowledge transfer between theorists, practitioners and the naval defence industry;
- Training officers specialised in emerging concepts such as Manned-Unmanned Teaming (MUM-T), A2/AD countering and underwater critical infrastructure protection;
- Active integration in NATO and EU research and innovation networks.

This school could constitute a **regional centre of excellence in emerging maritime doctrine** with long-term impact on collective security in the region.

[77] https://www.enisa.europa.eu/topics/eu-incident-response-and-cyber-crisis-management/eu-cyclone

Recommendations trans regional

Adoption of a framework for extended NATO-EU-NATO naval co-operation with neighbouring partners

The Black Sea, the Mediterranean and the Baltic Sea are interdependent maritime security zones. Establishment of a NATO-EU-Eastern Flank Partners Tri-Regional Maritime Platform It is recommended that a Tri-Regional Maritime Platform be established to link naval doctrines and rapid response initiatives among NATO member and partner states with an opening to the Black Sea, the Baltic Sea and the Mediterranean Sea. This platform would aim to:

1. **The doctrinal and operational alignment of** the naval forces of Romania, Bulgaria, Poland, Turkey, Italy, Greece and Croatia, in co-operation with strategic Eastern partners - Ukraine and Georgia.
2. **Expanded interoperability between naval and civilian forces (coasts, harbours, army**, maritime administration), with a focus on critical infrastructure resilience, combined surveillance (C4ISR), intelligence sharing and strategic maritime traffic control.
3. **Joint training and real-time data exchange** through tactical exercises and cyber and hybrid simulation campaigns in coordination with NATO Allied Maritime Command (MARCOM) and the European Defence Agency (EDA).
4. **Support collective security through a regional network of naval centres of excellence**, including a possible Centre for Asymmetric Maritime Operations in Constanța.
5. Complementarity of forces available for mission-centred joint actions.

This initiative would help strengthen cohesion on the Eastern flank and reinforce the maritime security architecture in an era of hybrid warfare, strategic competition and regional energy insecurity.[78]

Creation of a European Maritime Critical Infrastructure Defence Network (EM-CN-CMIRN)

In the area of heightened vulnerabilities of critical maritime infrastructure in Europe - such as gas pipelines, submarine communication cables, offshore platforms and naval logistic hubs - the establishment of a European Maritime Critical Infrastructure Defence Network (EM-CN-CM-CIN) is becoming essential. This network would function as a coordinated mechanism for surveillance, protection, rapid response and information exchange, integrating the resources of Member States, European agencies and strategic industrial actors.

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[78] Atlantic Council Task Force on Black Sea Security. "A Security Strategy for the Black Sea." *Atlantic Council*, 15 December 2023. Accessed 5 April 2025. https://www.atlanticcouncil.org/in-depth-research-reports/report/a-security-strategy-for-the-black-sea/.
https://www.atlanticcouncil.org/in-depth-research-reports/report/a-security-strategy-for-the-black-sea/.

Inspired by existing initiatives at NATO and EU level to protect submarine cables in the North Atlantic and North Sea - such as *NATO's Critical Undersea Infrastructure Coordination Cell* or the bilateral cooperation between the UK, Norway and Germany - RE-AICM would extend this operational framework to the European Union maritime space, with a focus on:

a) **Monitor and protect maritime critical infrastructure** through common artificial intelligence platforms, satellites, ships and maritime drones;
b) **Implement common resilience standards** for private and public operators involved in infrastructure management;
c) **Regular interoperability exercises** between national navies, civil protection agencies and port authorities;
d) **Setting up a European Maritime Incident Response Cell (EU-MAR-CERT**) to detect, analyse and counter cyber or physical attacks on infrastructures.

The proposal contributes to strengthening **European strategic autonomy** and is in line with EU priorities on energy security, defence of digital communications and protection of maritime supply chains.

Supporting the development of a "digital fleet" in the wider Black Sea area

In the geopolitics marked by Russian military aggression and the reconfiguration of the strategic balance in the Black Sea region, the transition towards a **"digital fleet"**, capable of operating autonomously, efficiently and interconnected in complex and contested environments, is becoming urgent. This digital fleet would integrate:

a) **Naval patrol and attack drones** capable of operating in denied access (A2/AD) conditions;
b) **Autonomous Underwater Vehicles (AUVs**) for sea mine detection, electronic spying and reconnaissance in hard-to-reach areas;
c) **AI systems analysing real-time maritime traffic and underwater acoustic signatures** for early warning and decision support;
d) **C4ISR capabilities integrated** (command, control, communications, computers, computers, intelligence, surveillance and reconnaissance) into the EU and NATO defence architecture.

Black Sea littoral states, such as Romania and Turkey, together with Poland (as a regional actor with experience in military technology development and transatlantic partnerships), should act as hubs of innovation and operational experimentation for the implementation of this new naval paradigm. The initiative could be supported by European funds (e.g. *European Defence Fund, PESCO*) and partnerships with the defence industry, including through the involvement of strategic players such as MBDA, Rheinmetall, Havelsan or emerging companies in the field of robotics and artificial intelligence.

It is a strategic direction that will enable the Black Sea region to break out of the vulnerability paradigm and become a European maritime military innovation laboratory, enhancing deterrence and rapid response to hybrid threats.

Strengthening doctrinal interoperability through a Regional Maritime Hybrid Warfare Readiness Centre (RMARWRC)

The proliferation of hybrid threats and the systematic use of strategic denial tactics by the Russian Federation in the Black Sea area requires the strengthening of doctrinal interoperability between allied and partner naval forces in the region. A viable solution is the establishment of a Regional Maritime Hybrid Warfare Readiness Centre for Hybrid Maritime Warfare (RMARHWC), with proposed headquarters in Constanța, Romania - a geostrategically relevant port and military infrastructure already partially adapted to NATO requirements, capable of developing:

a) **Joint training modules** in electronic warfare, jamming tactics and neutralisation of enemy communications;
b) **Applied courses on the use of naval and aerial drones** in reconnaissance, surveillance and precision strike missions;
c) **Advanced simulations of amphibious operations and rapid landings**, with a focus on joint cooperation;
d) **Specialised training for the detection, neutralisation and disposal of sea mines**, including autonomous and semi-autonomous robotic systems;
e) **Joint table-top and live exercises** coordinated with experts from NATO centres of excellence and European military institutions.

The HPRMRC could be developed in synergy with existing initiatives such as the Centre of Excellence for Countering Hybrid Threats (Helsinki) and the NATO Maritime Interdiction Operational Training Centre (Crete), but would specifically address the needs of adaptation to hybrid maritime warfare in the Pontic context.

Through its functioning, the centre would not only contribute to increasing the joint response capability, but also to building a common body of knowledge and operational practice in the Euro-Atlantic area, strengthening the strategic link between the Eastern flank and NATO's central structures.

The Romanian Naval Forces must adopt a coherent modernisation strategy, based on the relevant lessons of the Russian-Ukrainian war and calibrated according to the current geopolitical dynamics of NATO's Eastern flank. This strategy cannot be reactive or piecemeal, but must be multidimensional, integrative and long-term oriented.

Possible approaches for the Romanian Navy - Strategic Multidimensionality

The war in the Black Sea has demonstrated that naval power projection no longer depends solely on tonnage, armour or armaments, but on the fusion of traditional capabilities with emerging technologies. We can see for exemplification the use of naval drones by Ukraine has highlighted the importance of autonomous

systems in contemporary maritime conflicts. The NRF therefore needs to extend its doctrine beyond classical approaches, taking stakes in areas such as.

a) Electronic warfare (EW) and naval cyber defence;
b) Autonomous systems and maritime drones, including the possibility to operate them on board ships;
c) Artificial intelligence applied in ISR and maritime traffic analysis;
d) Distributed maritime operations and active dispersion tactics.

We are facing a new paradigm that requires an institutional culture that integrates both technological innovation and doctrinal adaptability.

Allied and civil-military integration

No littoral state can manage the complexities of modern maritime threats alone. Romania must continue the full integration of the NRF into NATO C4ISR networks, as well as proactively participate in the development of integrated regional capabilities, especially with Turkey and Poland. Civil-military cooperation must be strengthened, both in the field of port defence and logistical infrastructure, and in the management of critical maritime resources. The resilience models tested in Norway, Poland or the United Kingdom demonstrate that an effective national maritime strategy is an inter-institutional one based on realistic rapid response scenarios. [79]

Long-term projection and structural resilience

The NRF needs a coherent, long-term vision in which acquisition, training, doctrine and infrastructure projects are linked and logically sequenced. Romania's recent plans to acquire new warships to strengthen its Black Sea fleet emphasise the importance of such a vision. Multifunctional corvettes, light corvettes, submarines, naval drones or EW capabilities should not be seen as isolated acquisitions, but as parts of a coherent and resilient naval ecosystem. We envisage:

a) Reforming naval military education through a hybrid doctrine and innovation school;
b) Participation of naval forces and shipyards in EU-initiated projects such as the European Patrol Corvette project;
c) Investments in dual-use infrastructure (Mangalia, Constanța Sud);
d) A predictable legislative and budgetary framework to allow the gradual implementation of the new naval architecture.

This is a decisive moment for Romania's maritime future. The transformation of the Naval Forces is not just a military necessity, but a strategic imperative that will determine the Romanian state's ability to act as a security provider in the Black Sea and guarantor of the Eastern flank in the coming decades.

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[79] "Russian-Ukrainian crisis (2021-2022)." *Wikipedia: the free encyclopedia*. Last modified: [date last modified]. Accessed 5 April 2025. https://ro.wikipedia.org/wiki/Criza_ruso-ucrainean%C4%83_(2021-2022). https://ro.wikipedia.org/wiki/Criza_ruso-ucrainean%C4%83_(2021-2022).

Changing the model: from passive defence to active deterrence. The need to redefine the role of the Romanian Naval Forces in NATO's maritime security architecture

Central argument:

"NATO does not defend what a member state is not prepared to defend on its own."[80]

Over the last thirty years, the development of the Romanian Naval Forces has been deeply marked by a doctrinal perception specific to the post-NATO accession period, characterised by a minimalist, defensive approach, which privileged the idea that membership in the North Atlantic alliance automatically equals guaranteed security of the national maritime space.

This pattern of almost exclusive strategic dependence on NATO has inevitably led to chronic under-funding of the Romanian naval component, stagnation of modernisation programmes and neglect of building its own naval deterrence and projection capabilities .[81]

The events unfolding in the wider Black Sea region in the period 2022-2025 - generated by the Russian-Ukrainian war - have demonstrated with undeniable clarity that the survival of a littoral state in the face of a direct military threat cannot depend exclusively on allied solidarity, but on its own level of preparedness, capabilities adapted to new forms of conflict and the existence of a credible naval force capable of generating unacceptable costs to any potential aggressor. Moreover, NATO doctrine itself implicitly confirms this strategic truth: The Alliance is strong to the extent that each member is itself strong, ready and able to resist until the collective defence mechanisms are fully activated[82] . Therefore, a paradigm shift is required in the planning and development of the Romanian Naval Forces, from a symbolic or purely defensive presence model to a deterrent, adaptable force model, operationalised on the *Sea Denial* concept, capable of protecting national maritime interests and actively contributing to the security of NATO's south-eastern flank.

In this new paradigm, the acquisition in the first phase of Offshore Patrol Vessels (OPVs), together with the development of asymmetric warfare and hybrid warfare capabilities, are no longer mere modernisation options, but become essential elements of a strategic architecture of active deterrence, adapted to the new geopolitical and doctrinal realities in the Black Sea.

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[80] implicit doctrine of credible collective defence

[81] Cristian Barbu, Romania's Naval Forces post-2004: Realities and Perspectives, Military Publishing House, 2021

[82] NATO Defence College, Strategic Adaptation in the Black Sea Basin, Research Paper No. 218, Rome, 2024.

Strategic conclusion

Romania must become in the Black Sea what Poland has become on NATO's eastern land flank:

A resilience pivot state, capable of sustaining the first 7-10 days of naval conflict on its own, blocking, delaying, striking and turning any attempted aggression into an unacceptable strategic cost.

This is the future of smart, modern and deterrent naval forces.

The need to develop a National Strategy for Romania's Maritime Security: between the imperatives of the geostrategic reality and the strategic obligation of the present

"In the absence of a clearly defined National Maritime Security Strategy, any development of naval capabilities risks remaining piecemeal, reactive and lacking an integrative vision."

Romania is today the only NATO littoral state in the Black Sea that does not have a national strategy dedicated to maritime security - in the broad, inter-institutional and trans-sectoral sense of the concept.

In the dynamic and deeply volatile context of regional security in the wider Black Sea basin, Romania faces a fundamental challenge: the lack of a unified and officially recognised strategic vision for its own maritime space.

If in the past this absence could perhaps be justified by the relative stability of the regional environment and membership in collective security architectures (NATO and the EU), the conflict triggered by the Russian Federation against Ukraine in 2022 has definitively invalidated the paradigm of passive expectation and exclusive dependence on the guarantees of a strategic ally.

Thus, it becomes not only opportune, but urgently necessary, to develop and adopt a *National Maritime Security Strategy for* Romania - understood not as a marginal technical document, but as a fundamental integrating framework of security, defence, maritime economy and national resilience policies.

Moreover, the analysis of contemporary naval conflict has demonstrated that maritime space is no longer strictly delimited by traditional naval operations, but extends to a wide range of strategic interests and responsibilities, including: protection of offshore energy infrastructure, securing exclusive economic zones, freedom of navigation, defence of submarine communications, control of strategic maritime traffic and prevention of hybrid threats.

A National Strategy for Maritime Security would allow Romania not only to correctly dimension its naval capabilities (including the urgent integration of OPV vessels), but also to coherently articulate the inter-institutional relationship between the military, civil and economic structures involved in the management of maritime space.

By adopting such a Strategy, Romania could overcome the condition of an exclusively geographic maritime actor, assuming the status of a real strategic actor in the Black Sea - a state capable of defending its

vital interests and of actively and credibly contributing to the collective security architecture of NATO and the European Union.

In the absence of such a vision, the development of the Romanian Naval Forces risks to remain a fragmented, reactive endeavour, lacking long-term strategic projection.

Therefore, the following strategic truth is required as a doctrinal and operational foundation:

Without a National Maritime Security Strategy, Romania remains a maritime actor geographically, but not strategically.

11. Final considerations: changing the naval warfare paradigm

Classic naval warfare, with large fleets clashing, did not occur in this conflict. Instead, we witnessed a type of 'hybrid naval warfare', where one side (Russia) used the fleet as an extension of its land force and suffered defeats mainly by non-naval means, and the other side (Ukraine) achieved naval victories without a traditional navy, using artillery and robotic tools. The fact is reminiscent of how new weapons have transformed warfare in other eras - for example, how torpedoes gave us aircraft carriers (example: the sinking of the battleship *Prince of Wales* by Japanese aircraft in 1941, an event that signalled the end of the battleship era). Now, drones and missiles may signal *the end of the era of unprotected cruisers*, perhaps even restricting the role of aircraft carriers in contested areas.

In the Black Sea, the end of 2023 brought an unusual situation in which neither Russia nor Ukraine could use the sea freely - the Russians for fear of attack, the Ukrainians because they had no ships and their harbours were under aerial threat anyway. A former French admiral said: "Today there are no Ukrainian or Russian warships in the Black Sea. Because [any] is detected, tracked and targeted if you want"[83] . This is *"the first war to reach this point,"* he remarks. It's an important realisation: information supremacy and remote firepower have made the sea *deadly* for ships, as hostile an environment as the skies would be for slow bombers in other eras.

So, globally:

a) We can expect an acceleration of research into next-generation anti-ship weaponry: hypersonic missiles (Russia already has Zircon, China DF-21D anti aircraft carrier), supersonic drones, smart torpedoes. It will be a race between *sword and shield*: how to strike safer vs. how to defend better. The war in Ukraine gave a clear advantage to the sword (the offensive), the Russian shield proved outmatched.

[83] In the current context of the Black Sea conflict, former French Admiral Pascal Ausseur noted that no Ukrainian or Russian warships are operating in the area, as any such vessel would be quickly detected, tracked and, if desired, targeted. This observation emphasises the high level of surveillance and control in the region, which significantly limits the conduct of naval operations by the parties involved.

b) Coalition Doctrines - NATO will analyse how it would work together in a naval conflict. Example: if one NATO state is attacked by drone swarms, how do the others react? It's a new interoperability challenge.

The conflict has shown that maritime dominance is no longer guaranteed by historical legacy or tonnage, but must be earned and maintained through constant adaptation and anticipation of new threats. Russia, which has enjoyed dominance in the Black Sea for centuries (with the exception of the brief post-1918 period), has learnt in 2022-2025 what it is like to lose that dominance to a much smaller adversary, but aided by technology and international support.

For Russian naval doctrine, this will likely generate a reflex of caution and an emphasis on asymmetric means (ironically, the Russians themselves will take lessons from asymmetric). For others, it's a *wake-up call*: anyone relying on its navy's strength must take into account threats from multiple domains - air, land, cyber - that can turn a fleet into a pile of beasts in a matter of months.

The consequences were and remain:

- **Strategic-military:** Russia can no longer credibly threaten landings at Odessa or total control of the Black Sea. On the contrary, it has to defend its own harbours and convoys. The balance of power in the region has shifted: Turkey remains the main local naval power, and Russia no longer clearly outstrips it as before (Turkish or even Romanian/Polish military power with NATO equipment can oppose Russian targets.) Ukraine, with Western support, has achieved a situation of **denying** Russians **access** to its neighbouring waters, which gives it a valuable asymmetric advantage.
- **Economic-logistics:** Moscow faces difficulties in securing its sea routes. The blockade imposed on Ukraine has been largely broken, and Russia sees itself partly isolated - it cannot stop Ukrainian trade without risk, while its trade, though continuing, is conducted under the spectre of threat and at increased cost. *"Russia's dominance in the Black Sea has been called into question"*, which means that Russia's economic security in the region is no longer guaranteed by the presence of its fleet either.
- **Technological-tactical:** The war validated the role of precision weapons and drones in the naval environment. It also illustrated the vulnerability of large ships to these threats. Through Ukrainian ingenuity, concepts such as *naval drones* have moved from theory to practice. The global military community will intensively analyse these innovations. A Wilson Centre report notes that Ukraine *"has sunk or disabled one-third of the Russian fleet, forcing the rest to move eastwards"* using mainly drones and land-based missiles - which is remarkable. Ukraine's allies have also learnt from Ukraine's successes, seeing how their support can tip the balance and emphasising the importance of further strengthening Ukrainian capabilities in the Black Sea.
- **Doctrine:** Russia will have to thoroughly revise its naval doctrine, integrating the hard lessons it has learned: from how to protect ships, to recognising that naval superiority can no longer be taken for granted even in a "traditionally Russian" sea. At the same time, NATO countries and beyond will be

drawing conclusions - how *a seemingly inferior fleet can defeat a superior fleet* will go into strategy textbooks. This conflict is likely to become as influential a case study as the Falkland War (1982) or World War II in the Pacific in terms of lessons about naval technology and tactics.

- **Geopolitically**, the importance of the Black Sea as a strategic theatre has been revalidated. It is a region where European security, global grain trade and Russian power ambitions intersect. The war has shown that whoever controls (or denies the enemy control of) the Black Sea has a crucial advantage. For Ukraine, maintaining pressure on the Russian fleet remains vital to prevent attacks at sea and keep its export routes open. For Russia, regaining at least partial naval freedom of action (e.g. by concluding an agreement to limit attacks in the Black Sea) would be a goal - which is why they have sometimes negotiated the resumption of the Grain Treaty, hoping for exchanges that would allow them to put their fleet back in position.
- **The naval campaign** in the Russo-Ukrainian War 2022-2025 turned from a seemingly secondary episode (given that the initial focus was on land battles) into a decisive factor reshaping the balance of power. The strategic collapse of Russia's Black Sea Fleet greatly reduced Moscow's ability to achieve its original goals in the conflict, provided Ukraine with tangible and much-needed morale and economic successes, and demonstrated to the world that the era of unchallenged naval dominance may fade in the face of innovation and determination from a weaker but intelligent defender.

In the light of all this, Russia's naval collapse in this conflict serves as a warning that in modern warfare, innovation and adaptability can defeat brute force, and underestimating a weaker opponent can lead to disaster. Russia is paying the price for these lessons in the Black Sea; it remains to be seen how it will act going forward and how the rest of the world will use these lessons to prevent future maritime conflagrations or be prepared when they arise.

ANNEX 1- Table with the results of the attacks on the Black Sea Fleet

NR	Name	Dată	Results	Loc	What he hit
1.	Patrol boat pr. 03160 Raptor 	21.03.2022	Destroyed	Sea of Azov, near Mariupol	ATGM
2.	Large landing craft pr. 1171 (code "Tapir") "Saratov" 	24.03.2022	Destroyed	in Berdyansk harbour, Sea of Azov	Tochka-U
3.	Missile frigate Project 11356R Admiral Essen 	05.04.2022	Deteriorated	north-west Black Sea	"Neptun" anti-ship missiles,
4.	Project 1164 "Atlant" "Moskva" missile cruiser 	14.04.2022	Destroyed	north-west Black Sea	2 "Neptun" anti-ship missiles
5.	Patrol boat pr. 03160 Raptor 	02.05.2022	Destroyed	Black Sea, Zmiinyi island area	UAV Bayraktar TB2
6.	Patrol boat pr. 03160 Raptor	07.05.2022	Destroyed	Black Sea, Zmiinyi island area	UAV Bayraktar TB2

					
7.	Landing craft Project 11770 "Serna" 	07.05.2022	Destroyed	Black Sea, Zmiinyi island area	UAV Bayraktar TB2
8.	Patrol boat pr. 03160 Raptor 	07.05.2022	Destroyed	Black Sea, Zmiinyi island area	UAV Bayraktar TB2
9.	Landing boat pr. 02510 BK-16 	May 2022	Destroyed *(requires further clarification)*	Black Sea, Zmiinyi island area	UAV Bayraktar TB2
10.	Salvage tug pr. 22870 "Vasily Bekh Saviour" 	17.06.2022	Destroyed	Black Sea, near Snake Island	Attack 2 of the Harpoon anti-ship missile system
11.	Landing craft Project 11776 "Shark" 	02.07.2022	Deteriorated	Sea of Azov, near Mariupol	Marine mine

12.	Patrol boat pr. 03160 Raptor 	24.07.2022	Destroyed *(requires further clarification)*		Bayracktar then 2 UAV attacks
13.	Patrol boat pr. 03160 Raptor 	24.07.2022	Destroyed *(requires further clarification)*		Bayracktar then 2 UAV attacks
14.	Patrol vessel (corvette) Project 22160 "Vasily Bykov" 	04.08.2022	Deteriorated *(to be clarified)*	Black Sea near Sevastopol roadstead	maritime drone
15.	The sea minesweeper pr. 266M "Ivan Golubets" 	29.10.2022	Deteriorated	Black Sea raid in Sevastopol	maritime drone
16.	Project 11356R missile frigate Admiral Makarov 	29.10.2022	Deteriorated	raid in Sevastopol	maritime drone
17.	Project 864 Medium Reconnaissance Ship Azov	11.06.2023	Deteriorated	area south-east of Sevastopol	maritime drone

					
18.	Large landing craft pr. 775 "Olenegorsk Miner" of the Russian Northern Fleet 	04.08.2023	Deteriorated	near Novorossiysk	maritime drone
19.	Chemical tanker Project 52 "Whitefish", IMO: 9735335 *(used in the interest of the Ministry of Defence of the Russian Federation)* 	05.08.2023	Deteriorate	near Kerci	maritime drone
20.	Small patrol boat pr. 640 KS-701 	03.09.2023	Destroyed	north-west Black Sea	UAV Bayraktar TB2
21.	Missile submarine pr. 636.6 (code "Varshavyanka") "Rostov-on-Don" B-237 	13.09.2023	suffered significant damage	Sevastopol shipyard dock	Shadow Storm Shadow (SCALP-EG) probable cruise missile
22.	Russian Baltic Fleet large landing ship pr. 775 "Minsk"	13.09.2023	suffered significant damage	Sevastopol shipyard dock	Storm Shadow (SCALP-EG) cruise missile

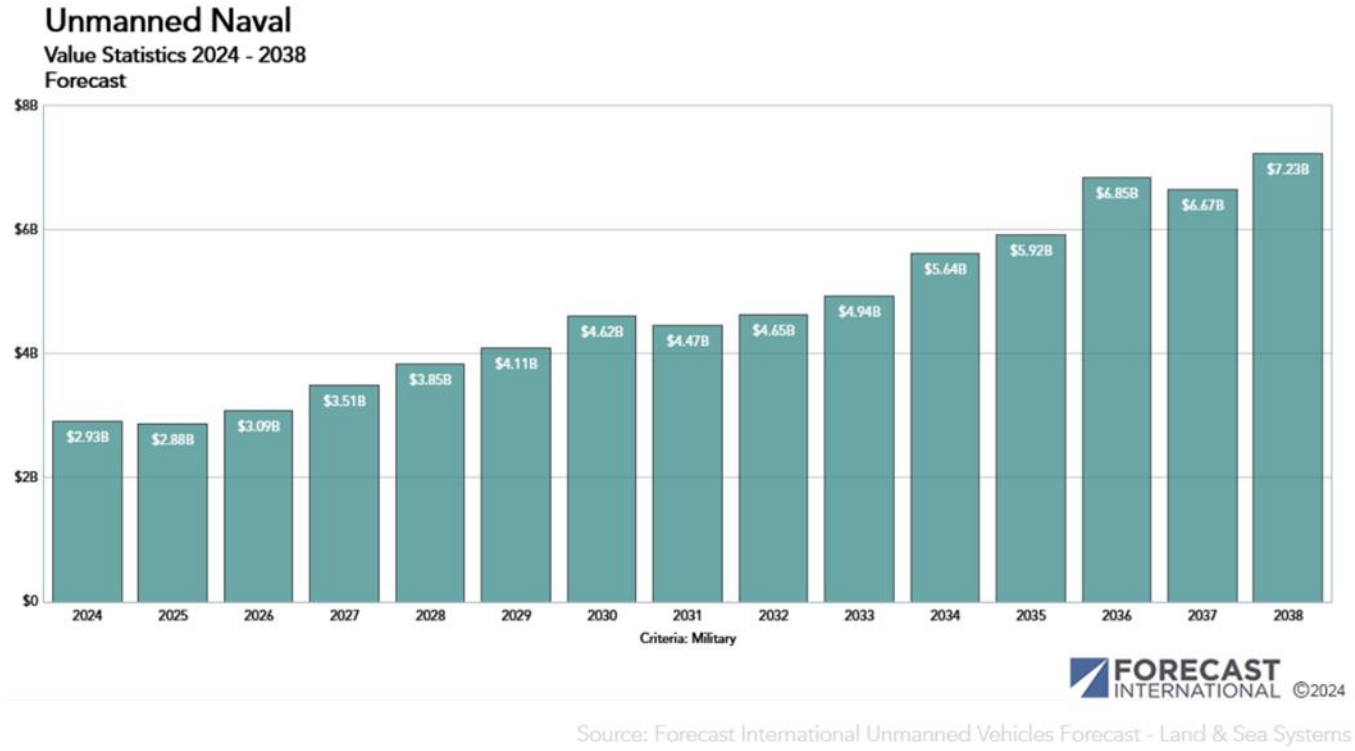
					
23.	Hovercraft mic pr. 1239 "Samum" 	14.09.2023	Deteriorate	Port of Sevastopol	maritime drone
24.	Patrol vessel (corvette) Project 22160 "Pavel Derzhavin" 	12.10.2023	Deteriorate	Sevastopol Street	Sea mines
25.	Rescue tug "Professor Nicolae Muru" 	12.10.2023	Deteriorate	Sevastopol harbour while towing the damaged patrol vessel Project 22160 "Pavel Derzhavin"	Sea mines
26.	Project of large hydrographic boat 23040G "Vladimir Kozytskyi" 	26.10.2023	Deteriorate	Sevastopol harbour during a survey of the water area for the presence of sea mines	Sea mines
27.	Maliy Project 22800 (code "Karakurt") "Askold" missile ship	04.11.2023	suffered significant damage	Zaliv shipyard, Kerci	2 Storm Shadow cruise missiles (SCALP-EG)

					
28.	Landing craft pr. 11770 "Serna" 	10.11.2023	Destroyed *(requires further clarification)*	Cape Tarkhankut area - Chornomorske village	maritime drone
29.	Landing boat pr. 11770 "Chamois" (possibly Project 11776 "Shark") 	10.11.2023	Destroyed *(requires further clarification)*	Cape Tarkhankut area - Chornomorske village	maritime drone
30.	The large landing ship Project 775 "Novocherkassk" 	26.12.2023	Damaged then destroyed	Damaged - Berdyansk, Sea of Azov; destroyed the harbour of Feodosia,	24.03.2022 Tochka-U rocket 26.12.2023 Storm Shadow cruise missile (SCALP-EG)
31.	Project 12411 "Ivanovets" 	01.02.2024	Destroyed	Lake Donuzlav, west coast of Crimea, near Yevpatoria	Maritime drone
32.	Large landing ship Project 775 "Caesar Kunikov"	24.02.2024	Destroyed	near Alupka, Crimea	Maritime drone

					
33.	Patrol vessel (corvette) Project 22160 "Sergey Kotov" 	05.03.2024	Destroyed	near Kerci	Maritime drone
34.	Large landing craft pr. 775 Yamal 	24.03.2024	Deteriorate (to be clarified)	Sevastopol harbour	Storm Shadow cruise missile (SCALP-EG)
35.	Large landing craft pr. 775 Azov 	24.03.2024	Deteriorate (to be clarified)	Sevastopol harbour	Storm Shadow cruise missile (SCALP-EG)
36.	Medium reconnaissance ship pr. 18280 "Ivan Khurs" 	24.03.2024	Deteriorate (to be clarified)	Sevastopol harbour	Storm Shadow cruise missile (SCALP-EG)

Annex 2-Maritime drones

The integration of autonomous military systems in the air, on land and at sea is revolutionizing modern warfare, delivering unmatched speed, precision and firepower. In the skies, unmanned aerial vehicles (UAVs) provide superior intelligence, surveillance, reconnaissance and strike capabilities. On the ground, autonomous combat vehicles amplify firepower, situational awareness and soldier protection. At sea, unmanned surface vessels (USVs) **significantly improve naval operations**, enabling sustained missions at a fraction of traditional costs. These advanced technologies are rapidly becoming central to future military strategies, with the programs highlighted here representing just a glimpse of broader efforts to develop and deploy cutting-edge autonomous systems.



Source: Forecast International Unmanned Vehicles Forecast - Land & Sea Systems

After the full-scale Russian invasion in 2022, Ukraine quickly built up an impressive unmanned naval force to compensate for the lack of ships and submarines.

Using unmanned surface vessels (USVs) armed with explosive payloads, Ukraine managed to inflict damage, namely 5 successful strikes, which accounted for 16.7% of the Russian Navy's losses.

These proved such a threat that the Russian fleet initially had to protect its ships in the harbors, after which it withdrew its ships and submarines to the southern Crimea and the port of Novorossysk.

A new, more protected but smaller naval base is currently being prepared in occupied Abkhazia in the port of Ochamchire.

This strategy gives Ukraine a degree of control over its waters that seemed unattainable a few years ago.

Video credit: https://www.youtube.com/watch?v=KO5djvv3CCs

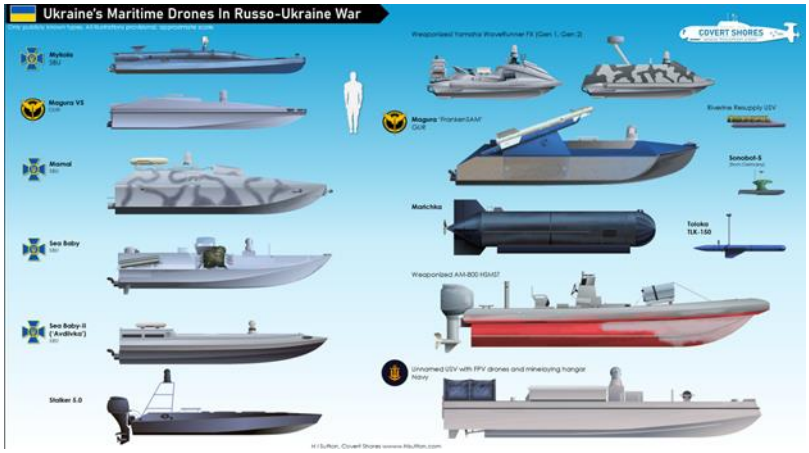
The success is primarily the adoption of unmanned platforms. They have opened up the possibility of operations previously impossible with manned vessels. Unmanned vessels can be built more compactly and require fewer resources. However, the use of maritime drones has some limitations arising from:

- The need to provide permanent satellite communications with low latency;
- Continuous use of positioning systems with unaltered (noisy) data;
- The necessary hydro-meteorological conditions to ensure safe navigation, these being small craft;
- Sufficient autonomy to be able to attack at long distances;

The revolution of unmanned vessels in Ukraine was feasible only thanks to two-way real-time satellite communications. Unmanned platforms existed before, but broadband communications allowed direct human control. This ensures faster deployment and instant adaptation to changing targets and missions. Starlink operates as the primary satellite communications provider, although Kymeta is also used. Automation and the use of artificial intelligence will lead to optimizing their use and reducing the need for human command, thus reducing the amount of communications required, but this still seems to be in the future.

There are interesting developments in semi or fully submerged versions. These fall into the UUV or AUV (Unmanned Underwater Vehicle or Autonomous Underwater Vehicle) category, but they have to rely heavily on AI in the absence of direct and continuous communications.

The figures below show the multitude of types of Ukrainian drones (progressively developed and tested), but also the existence of - lesser - Russian concern in this field.



Types of maritime drones developed by Ukraine

Source: http://www.hisutton.com/Russia-Ukraine-USVs-2024.html

Types of maritime drones developed by Russia

Source: http://www.hisutton.com/Russia-Ukraine-USVs-2024.html

Maritime drones Ukraine

Mykola

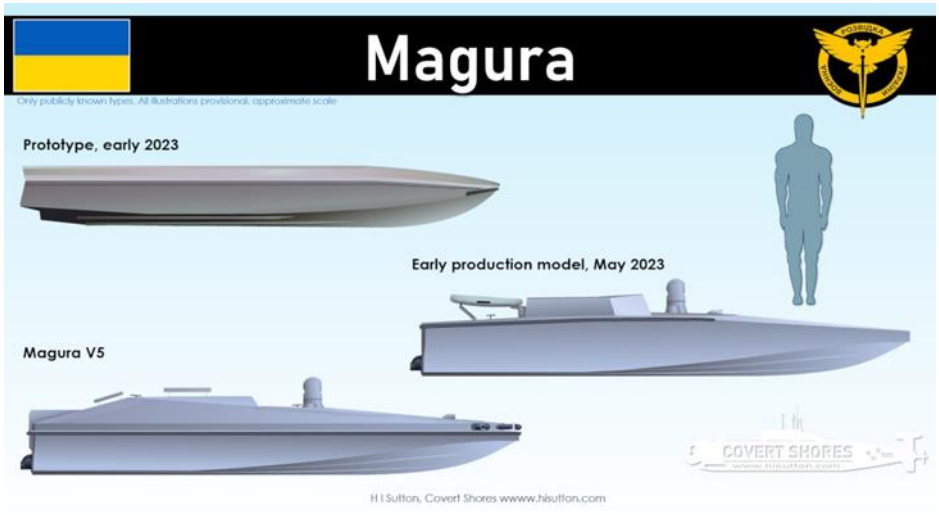
Ukraine's first USVs that were of the "**Mykola**" type, being used in September 2023, in particular in the raid on Sevastopol on October 29, 2022. These USVs were used, along with UAVs, to attack the Russian navy in the harbor. Two warships, the frigate *Admiral Makarov* and the minesweeper *Ivan Golubets* were damaged.

Specifications Mykola

Length: 5.5 meters; Overall weight: up to 1,000 kg; Range: up to 430 nautical miles (800 km); Autonomy: up to 60 hours; Battle load: up to 200 kg; Maximum speed: 43 knots (80 km/h); Navigation methods: automatic GNSS, inertial, visual; Video transmission: up to 3 HD video streams; Cryptographic protection: 256-bit encryption

Magura V5

The Magura V5 is the main type known to be in the service of GUR (Ukrainian Defense Intelligence Service). The images were made public until May 24, 2023, when they attacked the Russian Navy intelligence ship *Ivan Khurs*. This was significant because it occurred south of Crimea, showing the impressive range of the USV. The attack was unsuccessful, as was another attack on the intelligence ship, *Priazovye*, on June 11. The circumstances of these attacks are unclear, and it appears that some of the USVs may have been inoperable before they were attacked by Russian artillery. The new version is associated with the Magura V5 designation. Since then, the Magura has been involved in several missions and has sunk several high-value Russian vessels.



Specifications Magura V5:

Length: 5.5 meters; Width: 1.5 meters; Height above waterline: 0.5 meters; Speed: 22 knots cruising, 42 knots maximum; Range: 450 nautical miles (about 833 km); Payload: 320 kg; Communication: MESH network radio with an aerial repeater or satellite communication.

Magura V5 maritime drone by SpetsTechnoExport / Uprom

Toloka TLK-150 (Brave)

The small Toloka TLK-150 is a natural evolution of Ukraine's maritime drones, which are unmanned surface vessels (USVs) filled with explosives. Being an underwater vehicle, it is less prone to detection and harder to neutralize with gunfire. Its warhead is impact and below the waterline, so it might be most likely to sink its target.

The design is obviously intended to function as a form of homing torpedo. It consists of a typical tubular hull, but with a large keel and horizontal stabilizers amidships. Thrusters are mounted at the end of each horizontal stabilizer. Intuitively, they are used for both steering and propulsion. This should allow for

significant agility. If the mast is always above water, then technically you could argue that it is a semi-submersible. In this case, however, that distinction may be unnecessary. It is an armed UUV.

Toloka TLK-150 (Brave)

The tradeoff will be range and speed. Also the communications mast, which may contain an electron-optical camera, which will need to be above the surface. Although it has been shown publicly, it is not clear if it is used operationally. Several versions are expected, including one that is 4 meters long and claimed to have an operating range of 1200 km or 400 km.

Mamai

The Mamai was used by the SBU (Security Service of Ukraine) in attacks on the Ropucha Olenegorsky Gornyak-class Ropucha Olenegorsky Gornyak-class landing ship and the Sig tanker. Both attacks, far from Ukrainian-controlled territory, caused significant damage.

It is named after Kozak Mamai (Mamai/Mamay Cossack), a Ukrainian folk hero and one of the standard characters in the traditional Ukrainian puppet theater "Vertep". The design is much larger than the canoe-like USVs (unmanned surface vessels) first seen in September 2022. Like Magura it is used by GUR (Main Intelligence Directorate of the Ministry of Defense of Ukraine). However, its overall dimensions are still compact. The increased volume probably allows a large fuel load, giving a long range.

The design uses a planing hull that allows a reported maximum speed of 60 knots (110 km/h). One, sometimes two, satellite communication antennas are mounted and there is an electron-optical camera. The warhead is detonated by any of three impact sensors that are at the bow. These drones have proved reliable.

Sea Baby

The Ukrainian SBU operates the Sea Baby USV. It was used to attack the Kerci Bridge on July 17, 2023. The design is larger than the Mykola and Magura types, but overall quite small.

Sea Baby Specifications:

Length: 6 meters; Width: 2 meters; Height above waterline: 0.6 meters; Speed: 49 Nd max; Range: 540 nautical miles (1,000 km) with additional fuel tanks; Payload: 850 kg; Propulsion: 2 inboard 200 hp engines driving twin water jets; Communications: Satellite communications.

In addition to the main cargo, the Sea Baby can carry RPV-16 thermobaric missiles. Variations of two, four and six small missile tubes were seen. The missiles are unguided and have a range of about 1,000 meters. These weapons could serve multiple purposes. Besides being a primary way to attack a target, they could be used to defend against surface threats. During a contact-charge attack, missiles could be launched to distract or suppress defenses. The latter tactic was used on some Japanese Imperial gunboats in World War II.

The Sea Baby can be used to launch 6 x 122mm rockets. Several have been modified.

Improved Sea Baby, "Avdiivka"

The improved Sea Baby developed for the SBU was unveiled in early March 2024. A single 400 horsepower engine is used in place of the twin jet ski engines of the previous type. This allows for a 400-pound (some reports heavier) warhead. It has a range of about 500 nautical miles and a top speed in the region of 48 knots. Its hardened hull can ride waves 1.5 meters high, while its draft is about 1 meter and

height above the water 1 meter. Communications include both a Starlink directional antenna and a Kymeta satellite link. Although unconfirmed, it seems likely that, like the original Sea Baby, it can also carry missiles.

The large white antenna at the stern is Kymeta, while the smaller rectangular one is StarLink. In front of it is the electro-optical/infrared sensor.

Stalker 5.0

The Stalker 5.0 USV was unveiled at the International Black Sea Security Forum 2024 in Odessa. It is about 5 meters long and 1.2 meters wide and carries a payload of 150 kg. The vessel uses a 60 hp outboard engine to reach top speeds of 40 knots. Range is 350-600 km. The type is described as being intended for reconnaissance and patrol and can also be used for carrying supplies. The unit price is $60,000, making it cheaper than other models.

Marichka underwater drone (AUV)

Marichka (МАРІЧКА) is a new autonomous underwater vehicle (AUV) developed by AMMO Ukraine. Among many large AUV projects around the world, it is probably the first born directly out of wartime needs.

The basic vehicle is 6 meters long and 1 meter in dimeters. The construction is metal, all or most of the hull being a pressure vessel. A keel appears to exist along the bottom and there are towing rings, necessary for maneuvering and possibly for towing to more distant ranges.

Ammo Ukraine has touted the system as anti-ship, anti-pod, intelligence gathering and transportation. The range is 1,000 kilometers. The unit cost is 16 million UAH, equivalent to $433,000.

At least one of the prototypes has an X-shaped rudder configuration. Note the nose cone on the floor at the front of the vehicle.

Armed AM-800 RHIB

An unidentified USV was discovered floating upside down in Romanian waters on April 3, 2024. The vessel uses an American-built Silver Ships AM-800 Rigid Rigid Hull Inflatable Boat (RHIB) as its base. The warhead came from a STYX anti-ship STYX missile. The ship has not been officially assigned, but seems most likely Ukrainian.

Magura 'FrankenSAM' Air Defense USV

It is a Ukrainian unmanned surface vessel (USV) armed with an improvised air defense system with two AA-11 ARCHER (R-73) AA-11 missiles. Produced by Magura and used by GUR.

Riverine Resupply USV

USV logistics prototype USV observed with two ammunition containers (American type, for 120 mm or 155 mm projectiles). The ship is very small, around 1.5 meters long and has a payload of 30 kg.

Unnamed Ukrainian Navy USV with FPV drones

On December 7, 2024, the Commander of the Ukrainian Navy (VMS ZSU), Vice Admiral Oleksiy Neizhpapa, distributed a video of a new surface drone (USV - unmanned surface vessel) being used in the Black Sea. The craft is unique among previously seen types in that it has a hangar for at least 4 quadrotor FPV drones. It also appears to have a hangar for laying mines above the transom.

Dandelion

Dandelion (Dandelion) BBKN (ББВКН "Одуванчик") is a small USV developed by KMZ (Kingisepp Machine-Building Plant) in St. Petersburg. The latest image suggests a very different design from the RK-700 Vizir USVs previously commercialized by the company.

Limited information is available. According to reports, it can reach 80 kilometers per hour (43 knots) and has a range of 200 kilometers (108 NM). This would mean it has a shorter range than Ukrainian types. Its payload of 600 kg is similar. Most likely this would be a bow warhead, although many options can be considered. However, these specifications are remarkably similar to those published for the RK-700 Vizier design. So a reporting error is a distinct possibility.

Russia maritime drones

Murena 300S

The Murena 300S seems generally comparable to Ukrainian types. The Murena (Moray Eel) is about the same size as the Ukrainian Magura V5 and Sea Navy models. The manufacturer, LLC KB Center for Unmanned Systems, is promoting it for naval installation defense, mine laying, mine clearance, patrol and reconnaissance. On Sept. 19, 2024, it was displayed to President Putin while armed with 220mm UMT light 220mm torpedoes.

The drone has a simple metal housing similar to the classic Soviet-era Progress series. Unlike most but not all Ukrainian models, it has an external engine.

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