DOI: 10.53477/3045-2309-26-16

THE RISE OF NAVAL DRONES AND THE REDEFINITION OF THE MARITIME BATTLESPACE

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***Abstract**: Throughout the last century, naval power has relied on capital ships requiring years of design and billions in investment. This paradigm now faces unprecedented pressure from Unmanned Surface Vessels (USVs), commonly known as naval drones. The present paper aims to analyse how naval drones redefine the maritime battlespace in semi-enclosed seas and to derive implications for Romania's resilience in the Black Sea. The main objectives are: to trace the historical cycles of technological disruption in naval warfare, to examine the Black Sea as a live laboratory of naval drone employment, to extract lessons for similar theatres such as the Baltic Sea and the Taiwan Strait, and to develop a three-layer defence architecture for protecting critical maritime infrastructure such as the Neptun Deep project. Methodologically, the paper combines historical-comparative analysis, case studies (Ukraine, Baltic Sea, Taiwan), and doctrinal/strategic document review, integrated through a resilience-oriented analytical lens. The novelty of the study lies in linking operational-tactical drone employment with a concrete and scalable defence proposal for a NATO/EU coastal state whose Exclusive Economic Zone is outside the formal guarantees of Article 5. The expected outcome is a conceptual model of autonomous, multi-layered defence that can inform both Romanian and allied approaches to security in the Black Sea.*

***Keywords**: naval drones; unmanned surface vessels (USV); Black Sea conflict; asymmetric warfare; maritime defence; Neptun Deep; autonomous defence architecture.*

Introduction

Throughout naval history in the last century, command of the seas has relied on the size, range, and survivability of fleets composed of destroyers, cruisers, and aircraft carriers. These capital ships, often requiring years of design and billions of dollars in investment, symbolise both military and political power. However, this paradigm is now under unprecedented pressure with the rapid emergence of Unmanned Surface Vessels (USV), often referred to as naval drones.

Initially developed as cheap, expendable reconnaissance platforms suitable for shallow or contested waters, USVs have rapidly evolved into armed systems capable of executing precision attacks. Equipped with explosive payloads, navigation sensors, and remote control links, they can penetrate defences and threaten ships of much higher value. Results observed in recent years, particularly in the Black Sea, signal not just a major improvement, but a paradigm shift in naval warfare, where cost asymmetry favours the attacker.

The conflict in the Black Sea transformed Ukraine, left without a naval fleet after the annexation of the Crimean Peninsula and the 2022 invasion, into a pioneer of asymmetric warfare with drones like Magura V5 and Sea Baby. These platforms struck major Russian ships, broke the grain blockade, and contributed to the retreat of the Russian fleet, demonstrating how swarms of small drones can saturate expensive defences and reverse the strategic balance.

The phenomenon transcends the Black Sea, offering lessons for similar theatres such as the Baltic Sea or the Taiwan Strait, where semi-enclosed geography amplifies the efficiency of autonomous drones. Russia, China, the USA, Sweden, Türkiye, Australia, and others are investing massively in USVs, UUVs (unmanned underwater vehicles), and next-generation submarines, recognising that the naval future means distributed networks, not isolated ships.

Romania could transform this threat into a strategic advantage by adopting a multi-layered defence inspired by Ukrainian lessons: swarms of light USVs for continuous surveillance, autonomous interceptors with kinetic weaponry, and reactive mines designed to neutralise attacks, integrated into multi-domain operations (MDO, coordinated with aerial and terrestrial drone systems. An industrial partnership with neighbouring and partner countries, based on expertise in autonomous robotic systems and the capabilities of the Constanța-Mangalia shipyards, would generate 50-100 USVs annually. Such an initiative could be financed by revenues generated by the Neptun Deep project, complemented by EU/NATO funding mechanisms. In this way, Romania could transition from a vulnerable target into a regional provider of maritime security. This approach would ensure the protection of energy independence while redefining the role of the Black Sea as a bastion of European resilience.

This paper pursues four main objectives: (1) to place naval drones within the longer historical cycles of technological disruption in maritime warfare; (2) to analyse the Black Sea as a recent laboratory where Ukraine has operationalised USVs under conditions of conventional naval inferiority; (3) to extrapolate applicable lessons for other semi-enclosed theatres, notably the Baltic Sea and the Taiwan Strait; and (4) to propose a three-layer defence architecture for Romania aimed at protecting critical offshore infrastructure in a high-threat, hybrid environment. To achieve these objectives, the research employs a qualitative methodology based on historical-comparative analysis, open-source case studies, and the examination of official strategic documents and expert literature, interpreted through the conceptual lens of resilience and multi-domain operations. The study is structured as follows: Chapter 1 reviews past technological disruptions at sea; Chapter 2 analyses Ukrainian naval drone employment in the Black Sea; Chapter 3 develops parallels with the Baltic Sea and the Taiwan Strait; Chapter 4 synthesises the tactical-operational advantages of USVs; Chapter 5 presents Russia's response and selected Western countermeasures; Chapter 6 focuses on Romania's military and diplomatic response, with emphasis on a proposed three-layer defence model; the final chapter summarises the main findings and policy-relevant conclusions.

1. Historical Foundation: Cycles of Technological Disruption

For over a century, the balance of naval power has been based on the strength of capital ships − battleships, aircraft carriers, submarines, and missile destroyers. Each era was defined by a dominant platform that seemed unassailable, only to be ultimately replaced by a disruptive newcomer. The battleship sparked an arms race but was eclipsed by the aircraft carrier within a few decades. Submarines, initially viewed with scepticism, became critically important elements, threatening to sever transatlantic supply lines in both world wars. Guided missiles extended lethal range and reconfigured tactics during the Cold War, forcing naval forces to distribute risk across multiple escort ships rather than concentrating it in a few powerful vessels (Till 2018).

What unites these historical changes is the rhythm of paradigm rupture: fleets optimised for a particular paradigm are destabilised by an emerging technology that renders older investments insecure. Within this historical continuum, the rise of unmanned surface vehicles (USVs), popularly known as naval drones, represents more an echo of transformations than an abrupt break from the past. Just as submarines reshaped perceptions of invisibility, and aircraft carriers extended the battlespace vertically into the air, USVs embody a horizontal dispersion of power across cheap, expendable, yet adaptable vessels. Their emergence reflects both a military necessity and a technological opportunity.

The concept of uncrewed vessels is older than often assumed, with variants similar to contemporary designs emerged during both world wars, when engineers tested radio- and wire-guided boats packed with explosives, attempting to steer them toward port defences or anchored fleets.

(Osgood 2021) Rudimentary transmitters and short control ranges doomed most attempts, but they demonstrated the feasibility of delegating high-risk missions to uncrewed surrogates. The Cold War period brought gradual refinement: remotely operated vehicles, often tethered by cable or semi-autonomous, cleared naval mines, conducted near-shore reconnaissance, or simulated hostile targets during training. Like their aerial counterparts of that era − small target drones or reconnaissance prototypes − they occupied the periphery of warfare, proving useful but not decisive, and rarely integrated into doctrine.

By the end of the 20th century, three foundational pillars redefined the horizon: the precision of global positioning systems (GPS), the miniaturisation of optics and sensors, and digital communication links capable of reliably transmitting data through secure channels. These convergent technologies enabled small surface vessels to patrol independently, conduct intelligence-gathering missions, and transmit real-time local situational awareness. Initially, USVs resembled the UAVs of the 1990s: eyes in the sky − or, in this case, eyes on the water. Their strategic contribution remained modest, but the foundations of evolution were laid (Till 2018).

Armament inevitably followed. It was a short conceptual step from a reconnaissance hull carrying cameras to an expendable vehicle armed with an explosive payload. Where naval mines had long represented static threats, and torpedoes lacked the ability to loiter near targets for extended periods or self-guide over long distances, naval drones became mobile and intelligent equivalents − navigating autonomously to targets, adapting to defence systems, and evading interception. The design, combined with their low radar profile allowing surface navigation, posed a new challenge for defence systems optimised against aircraft or missiles, not swarms of small attack boats coordinating in fleets.

This shift fundamentally altered the cost calculus in naval warfare. A billion-euro frigate, laden with radars and defensive systems, might be forced to expend multiple million-euro missiles to destroy fast-moving attackers costing only a fraction of its value. This exchange asymmetry is precisely what made naval drones a disruptive power tool. Their expendable nature is not a limitation but an advantage − inverting the traditional logic that survivability is the primary attribute of naval design (Seligman and Berg 2023).

2. Black Sea: The Naval Drones Laboratory

The ongoing conflict in the Black Sea has provided the most visible demonstration. Ukrainian naval drones Magura V5 and Sea Baby have successfully struck Russian warships and strategic port facilities. These attacks demonstrate how vessels costing just tens or hundreds of thousands of euros/dollars can impose strategic costs far exceeding their price (Knickerbocker 2024).

Naval drones excel by exploiting gaps in conventional naval doctrine. Traditional ships rely on layered defence systems − radars, missiles, close-in weapon systems − optimised to defend against aircraft and manned vessels. However, small USVs, with low profiles and high speeds, are difficult to detect until they close to dangerously short ranges. Defending against a single drone is feasible; countering swarms of dozens arriving simultaneously from multiple angles presents a far more complex challenge. The psychological effect is also significant. Crews operating in contested waters now face persistent uncertainty, where any radar blip or fast boat could conceal a lethal drone. This constant threat reshapes operational behaviour, forcing ships to maintain distance or maximum alert status, reducing their effectiveness.

What makes the Black Sea unique as a framework for this transformation is its enclosed and semi-enclosed geography. Bordered by NATO members on one side and Russia on the other, the sea has historically served as a strategic buffer zone, with access strictly regulated by the Montreux Convention. This limited arena amplifies the effects of each attack, as there is little space for fleets to manoeuvre beyond detection range and reduced capacity to rapidly replace destroyed units.

The 1997 Treaty on the Status and Conditions of the Black Sea Fleet officially ended the dispute between Ukraine and Russia over the former Soviet Black Sea Fleet. Russia received approximately 81.7% of the fleet's assets, while Ukraine received coastal infrastructure and 18.3% of the fleet, consisting of over 40 warships, approximately 100 support vessels, and significant shipbuilding capabilities. Ukraine agreed to lease naval facilities in Crimea to Russia for 20 years (until 2017), receiving approximately $97 million annually. A supplementary agreement, the Kharkiv Pact (2010), extended the lease until 2042 in exchange for discounts on Russian gas. For Russia, the Black Sea Fleet became the principal element of regional influence and coercion, aimed at controlling commercial and military traffic in the area (United Nations 1997).

For Ukraine, early 2014 brought a major blow to its territorial integrity following Russia's annexation of Crimea. Due to disputes over the price and payment of gas supplied by Moscow, as well as Russian nationalist claims viewing this majority − Russian population territory as part of the federation, an army of "little green men"/"flagless" soldiers executed a special annexation mission. Following this event, Russia began strictly controlling Ukrainian vessels' access to ports within the Sea of Azov and around the peninsula. In the subsequent years, Russian pressures became increasingly evident through the fleet's total superiority over naval traffic, with Crimea increasingly becoming an outpost for electronic warfare and aerial intimidation. In 2018, three Ukrainian ships were attacked and detained in the Kerch Strait area (International Tribunal for the Law of the Sea 2019). Movement restrictions across the entire Ukrainian coastal area made access to offshore drilling facilities impossible, further damaging the economy. The surprise launch of the 2022 attack took out the last significant ships, rendering Ukraine's naval forces irrelevant from the perspective of classical confrontation.

However, precisely this situation led to the discovery of alternative naval combat solutions. As the dominance of large Russian ships left no room for classical confrontation, Ukrainians saw maritime drones and coastal anti-ship missiles as the only method to rebalance the complicated combat situation in the Black Sea area. Once the possibility was discovered to use a Starlink terminal mounted on an aerial drone to establish long-distance communication, the idea emerged of using this system as a communication method on an explosive-laden boat to destroy Russian ships. Thus, Commander Oleksii Neizhpapa selected a small group of experts to support the maritime drone project. Their main role was to assist with calculations and, above all, to train drone operators in sea navigation, including in storm conditions and using old pilotage charts.

In June 2022, the first prototype − a standard motorboat with a Starlink system − that was constructed and successfully tested. By September 2022, the first drone team was operational and directed toward Sevastopol. The initial mission, however, failed due to the interruption of communications via Starlink satellites. This experience highlighted the necessity for multiple communication channels, and new models were equipped with three interconnected systems (Romaniuk 2024).

The night of 28-29 October 2022 marked the key moment of the first successful operation. Rain had subsided and sea conditions were favourable, allowing the modified drones to be deployed. Four drones were launched toward Sevastopol, while three others headed toward the southern peninsula where the frigate Admiral Makarov − the flagship of the Russian Black Sea Fleet following the sinking of the cruiser Moskva − was located. A Ukrainian drone successfully struck the ship's starboard side. The surprised crew attempted chaotic manoeuvres toward Sevastopol Bay. Two other drones pursued the frigate nearly to shore, though large waves prevented direct contact. The impact was serious − the ship was disabled.

Meanwhile, other drones penetrated Striletska Bay, but there an alarm was raised, a massive spotlight was used to target them, and they were countered. A Russian minesweeper, Ivan Golubets, appeared on an operator's screen, and the drones were ordered to destroy it with 108 kilograms of explosives. Other drones struck an oil facility in the area. In the confusion, Russian artillery also fired on its own flagship, resulting in friendly fire. Meanwhile, the remaining drones entered Sevastopol Bay. This may have been the first remote naval drone operation in modern history, and based on this success, it was decided that drones needed to be larger and carry more substantial explosive payloads to achieve greater impact (Romaniuk 2024).

With each new generation, the payload increased from 108 to 850 kilograms, and the drones were equipped with state-of-the-art communication systems, each costing over $300,000 USD/EUR. Their hulls became radar-invisible and received multiple other innovations, including a flamethrower system to make them more lethal against unprotected targets. In a landmark operation in May 2025, a Magura V5 drone achieved the first air-to-surface/naval drone victory, downing a Russian Su-30 fighter over the Black Sea (Grosswald 2025).

Ultimately, the philosophy changed: the intent became to segment the components of a large ship − air defence, weapons, defensive systems − and distribute them across multiple drones, fundamentally changing how fleet problems can be addressed, especially when building large ships is not feasible. This represents a new era of naval warfare, where strength is no longer defined solely by large, expensive ships, but by intelligent swarms of maritime drones capable of delivering rapid, precise strikes while seizing tactical initiative. Thus, drone operations, alongside new capabilities from shore-based anti-ship missiles, broke the maritime blockade to enable grain exports but also forced the Russian fleet's withdrawal from Sevastopol to the safety of Caucasian ports. This evolution marks the emergence of a new warfare paradigm: prolonged attrition warfare.

The scale and persistence of these attacks forced a third of the Russian Black Sea Fleet to be destroyed, disabled, or relocated, shattering the image of naval invulnerability (Allison 2025).

3. Applicable Lessons Beyond the Black Sea

The operational evolution in the Black Sea offers critical lessons for other geopolitically tense and narrow naval theatres, such as the Baltic Sea and Taiwan Strait, where geography, asymmetry, and the presence of strong maritime competitors create comparable dynamics and vulnerabilities (Till 2018).

The Baltic Sea shares numerous geographical and strategic characteristics with the Black Sea: both are semi-enclosed maritime theaters, relatively shallow (average 55m in the Baltic, 1,200m in the Black Sea), narrow straits, and dense fishing zones, bordered by NATO actors and Russia. The regional naval balance is profoundly influenced by the Russian Baltic Fleet, with its strategic bases in Kaliningrad and St. Petersburg, which dominate access to the Gulf of Finland, Danish Strait, and North Sea. In this constrained environment, with limited manoeuvre space and fragmented radar visibility, USVs capable of swarm operations represent an exceptional asymmetric tool for local naval forces.

These exploit shallow waters for natural camouflage, evade thermal and radar detection by traditional ships, and enable saturation attacks or persistent reconnaissance missions that disrupt Russian surface fleet operations without exposing human crews to risk. Recent naval confrontation experience reveals the defence paradox against USVs: it is much easier to attack than to defend. A swarm of small USVs, launchable from coastlines or civilian ports, can saturate the defences of a frigate or destroyer through the inability to destroy large numbers of naval drones with missile systems (CIWS, RAM) designed for aerial or ballistic threats, not agile and numerous surface targets.

The cost of a Ukrainian attack-type USV such as the Magura V5 (~$250,000 USD/EUR) is far lower than the price of a SeaRAM missile ($2M USD), creating a major economic imbalance (Seligman and Berg 2023). In the Baltic Sea, conventional layered defences − comprising torpedoes, barrage mines, and ASW aviation − must now anticipate rapid simultaneous attacks that outspace traditional sequential responses. This dynamic forces a radical rethinking of force positioning, distributed sensor networks, and autonomous systems, from cheap interceptor USVs to stationary barrage UUVs in critical straits like the Gulf of Finland or Øresund.

Fortunately, this region is not on the brink of open conflict − which would trigger Article 5 and a massive NATO response. The Russian Baltic Fleet, anchored at Kaliningrad and St. Petersburg, dominates access to the Gulf of Finland or Øresund, however, this fleet remains vulnerable to the Ukrainian combat model. Critical infrastructure, such as Gdańsk port (135 million tons of cargo annually), submarine cables (Baltic Connector), or pipelines (Baltic Pipe), becomes a priority target for hard-to-attribute attacks. Civil blockades masked as eco-protests or GPS jamming can hinder regional maritime traffic. Hybrid warfare is Russia's preferred path, enabling political/economic advantages through ambiguity, social polarisation, and logistic chain paralysis without risking total escalation. Essentially, Baltic hybrid warfare will persist at the edge of open conflict, where critical infrastructure resilience − not brute naval superiority −dictates victory, demanding clear national strategies, persistent vigilance, and accelerated regional cooperation.

The rapid development of this topic prompted the Swedish navy to expedite operationalisation of a large unmanned underwater vehicle (LUUV) for monitoring submarine cables and energy pipelines. This directly addresses vulnerabilities demonstrated by recent incidents, including damaged cables linking Lithuania-Sweden, Germany-Finland, and multiple Estonia-Finland connections. Through autonomous platforms capable of persistent underwater surveillance, Sweden aims to detect potential sabotage operations before they can cause critical damage (Shumlianskyi 2025).

Taiwan's strategic situation amplifies these lessons on a global scale, presenting major similarities with Black Sea/Baltic dynamics but challenges on a much larger scale. Surrounded by the expanding naval capabilities of mainland China/People's Liberation Army Navy (PLAN), Taiwan's defence operates in a narrow theatre (130 km-wide Taiwan Strait), with shallow waters in landing zones and potential for intensive blockades or amphibious assaults. At the 2025 military parade, Beijing displayed heavy-tonnage naval drones and UUVs (AJX-002, HSU-001), signalling intent to dominate this domain (Naval News 2025).

Open-source reports estimate that the People's Republic of China, with its massive industrial capacity achieving 200:1 superiority in naval construction over the US, could produce thousands of USVs annually through civil-military integration (military-civil fusion), leveraging commercial production chains in Shanghai, Dalian, and Guangdong to rapidly scale from prototypes to industrial series. The Chinese military can use maritime drones as sacrificial pawns as landing vanguards, launching thousands of cheap USVs in massive swarms to saturate Taiwan's coastal defences and create safe corridors for debarkation. This "volume vs. volume" strategy exploits force asymmetry: defences based solely on autonomous defensive boats could be relatively easily saturated and eliminated by a Chinese numerical avalanche.

Unlike Russia, China is in continuous expansion of its military force projection in the maritime domain and seeks a formula to counterbalance the US Navy's classic format power. One of the boldest initiatives is launching the first drone-dedicated carrier – a USV-docking experimental catamaran, observed in 2024 and intensively tested in 2025 – capable of deploying dozens of aerial and naval drones simultaneously for swarm-coordination operations (Trevithick 2024). Additionally, Beijing converts commercial cargo ships into hybrid combat platforms equipped with advanced radars, modular containerised missile launchers, and EMALS catapults for VTOL drones, transforming its massive civilian fleet (world's second largest, over 5,500 cargo ships) into "Q-ships" − hybrid systems capable of surprise attacks from apparently innocuous vessels for blockade scenarios. Armed cargo ships represent a critical element of supersaturation for US Navy defences, which must disperse forces during a hypothetical intervention to support Taiwan support. Moreover, the inability to quickly distinguish legitimate commercial targets from masked military platforms generates lethal operational hesitation (Sutton 2026).

In a pure "volume vs. volume" fight, China has the potential to rapidly seize the initiative. A combined attack with thousands of Chinese USVs (potentially 5,000+, based on PLA-tested swarm coordination capabilities and industrial production) could neutralise Taiwan's defensive network of hundreds of autonomous units in hours (Taiwan plans 1,600 USVs), forcing rapid consumption of limited ammunition stocks and exposing launch/coordination platforms (News Desk 2025). The only way to restore balance is a multi-layered autonomous defence, with an aerial tier: swarms of kamikaze UAVs and loitering munitions to suppress Chinese USVs en masse; a surface tier: interceptor USVs with kinetic weapons and anti-USV missiles; and a subsurface tier: barrage UUVs and persistent sensors. However, the underwater domain remains the hardest to cover. Chinese numerical supremacy in large UUVs can rapidly saturate simple radio-magnetic or passive sonar detection systems without dedicated active countermeasures.

4. Tactical-Operational Advantages

Beyond their capacity to launch direct attacks, the strategic and operational advantages of naval drones (USVs) introduce new elements into maritime warfare strategies, shifting from dependence on massive, costly ships to a network-based approach where resilience and adaptability are the defining attributes.

Some of the most significant advantages are their remarkable accessibility and scalability. Unlike traditional ships, which require years of construction and massive investments, naval drones can be mass-produced rapidly and upgraded with new components at much lower cost. This production speed enables naval forces to expand capabilities far more agilely than would be possible with conventional fleets (Jones and Parker 2025). Moreover, USVs offer extreme role flexibility. Although their notoriety stems from attack missions, their potential is vast. They can be used for long-term surveillance, launching diversion operations to distract the enemy, executing countermeasures against mines in hazardous areas, or even ensuring logistical resupply in hostile environments without risking human lives.

This flexibility intertwines with swarm tactics, a concept that amplifies impact. By operating in large numbers, USVs can initiate saturation attacks designed to overwhelm and exhaust enemy ships' anti-missile defences and guns. Even if a significant number of drones are destroyed, the overall cost to the attacker remains sustainable, while the adversary depletes costly defensive ammunition and becomes increasingly vulnerable (Jones and Parker 2025). Ultimately, naval drone usage leads to a significant extension of a fleet's range. By deploying uncrewed vehicles at the vanguard, a naval force can project presence into dangerous areas without risking personnel. This creates a distributed network of sensors and attack points across an extended geographic area, ensuring superior situational awareness and faster response capability.

Although their combat capabilities have drawn attention, one of the most transformative applications of naval drones may lie in logistical support. In any maritime campaign, sustaining resupply for ships, coastal bases, or island outposts constitutes a strategically critical element. Traditionally, resupply missions expose crewed ships to high risk levels in contested areas. Naval drones can change this dynamic in several ways. First, resupply in hostile environments: Small USVs dedicated to logistics can transport fuel, ammunition, food, and medical materials to forward operating bases or ships at sea, even through areas under surveillance or attack threat. Their utility as expendable resources reduces the strategic risk of losing high-value resupply ships.

Second, distributed logistics chains: Instead of relying on large, vulnerable tankers or transport ships, naval forces could deploy fleets of autonomous vehicles that distribute loads across multiple units. This resilient resupply network prevents single points of failure and ensures continuous support under attrition conditions. Naval drones can also be configured to evacuate wounded personnel or deliver medical kits to isolated crews in adverse weather conditions or dangerous areas, such as offshore drilling platforms unsuitable for helicopters or crewed ships. In highly contested military zones, USVs can sustain logistical resupply through autonomous maintenance of supply lines along randomly generated routes, avoiding potential ambushes. This transforms not only how naval forces fight, but also how they endure. A fleet can project power only as long as it is supplied − a principle that uncrewed logistics vehicles could protect in future conflicts.

The true potential of naval drones lies not in their ability to operate in isolation, but in their integration across multiple domains of action. Modern military forces, particularly NATO, place increasing emphasis on "Multi-Domain Operations" (MDO), a doctrine where success depends on simultaneous coordination of effects across land, sea, air, space, and cyberspace. In this vision, naval drones integrate seamlessly, serving as a maritime component that fluidly connects with other uncrewed systems.

While aerial drones are designed to extend range by providing real-time surveillance, target identification, and electronic warfare coverage, uncrewed ground platforms enhance logistics, command-and-control nodes, and defensive fires from the coast. In turn, naval drones bring water persistence, scalable attack capability, and flexible logistical support. The evolution lies in the ability to make all these systems collaborate. For example, aerial drones could identify enemy positions beyond the horizon, feeding real-time data to naval drones that could execute saturation attacks or deliver supplies under fire, while ground systems coordinate fires or secure coastal bases. In logistical scenarios, the same synergy ensures survival: ground drones deliver supplies to shore, naval vehicles transport them through contested waters, and aerial drones handle high-priority urgent deliveries.

This collaboration completely redefines the nature of the battlespace. Ultimately, future battles will not be fought solely by aircraft carriers and submarines, but by interconnected constellations of ground, aerial, and maritime drones cooperating within an MDO framework. Thus, naval drones will be considered not merely asymmetric attack assets, but an essential element in a broader system-of-systems that sustains resilience, ensures deterrence, and redefines what it means to control the battlespace.

5. Russia's Response and Western Countermeasures

The success of Ukrainian maritime drones did not go unnoticed in Moscow, prompting a comprehensive response that underscores both the strategic importance of this emerging domain and the rapidity with which states can mobilise autonomous capabilities when survival is at stake. Starting in April 2025, Russia established a high-level "Technical Council" for unmanned maritime systems, chaired by Admiral Alexander Moiseev and including members from the presidential administration, defence industry, and scientific community. In May 2025, the Russian Navy began forming specialised uncrewed regiments covering aerial, ground, surface, and subsurface domains, while in July the Kingisepp Machine Plant in St. Petersburg opened − a dedicated drone production complex manufacturing hulls, waterjets, and propulsion units, backed by a 2.7 billion ruble ($33 million) investment (Shumlyan'skyi 2025).

For submersible systems, Russia's capabilities present an even more sophisticated challenge. The "Main Directorate of Deep Sea Research" (GUGI), operating independently of the Russian Navy and reporting directly to the Ministry of Defence, maintains a range of deep-diving submarines, including titanium-hulled vessels "Losharik", "Paltus", and "X-Ray", capable of operating at extreme depths where sabotage damage would be particularly difficult to repair. European defence planners have not overlooked the implications of these Russian underwater capabilities, rapidly developing autonomous subsea systems to counter emerging threats to critical infrastructure.

Sweden recognised these threats and responded with a LUUV development project for the Swedish Defence Materiel Administration, a $6.3 million initiative with initial sea trials scheduled for summer 2026. The platform is designed to provide an autonomous sensor system capable of monitoring and mapping seabed infrastructure while simultaneously detecting and deterring subsea threats. The LUUV integrates Saab's "Autonomous Ocean Core" control system (Swedish defence systems manufacturer), enabling extended autonomous operations without direct human intervention − essential capabilities for countering Russia's sophisticated underwater warfare assets. Sweden's approach exemplifies this transformation, representing a fundamental shift in national defence philosophy from centuries of defensive strategy to what Rear Admiral Fredrik Lindén describes as "transforming into an offensive force to establish and maintain control in our area" (Naval News 2024).

Turning to persistence, the United States demonstrated with "Sea Hunter", produced under DARPA's ACTUV program, that uncrewed surface vessels can operate thousands of kilometres without crew. Initially designed for anti-submarine vessel tracking, Sea Hunter embodies the ambition to incorporate USVs as permanent operational assets, bridging intelligence missions and autonomous patrol. Türkiye's "ULAQ" represents another domain: a family of armed USVs developed locally with modular, interchangeable payloads for anti-ship missiles, electronic warfare packages, or surveillance. Its entry into regular naval service shows how mid-tier powers can bypass traditional large-ship bottlenecks while still demonstrating credible offensive capability in regional waters (Ekşi 2025).

Australia's "Ghost Shark" is a "very large uncrewed underwater vehicle" (uncrewed submarine/XLUSV) revealed in 2023 to counterbalance China's accelerated development in this sector. Designed for endurance measured in months, Ghost Shark can carry modular payloads from surveillance systems to attack systems. Its stealth and persistence indicate that drones are no longer limited to tactical expendable roles; they are transforming into strategic force multipliers capable of complementing − or even replacing − top-tier conventional assets in certain missions (Australian Ministry of Defence 2024).

6. Romania's Military and Diplomatic Response

The Black Sea can become a theatre of hybrid operations where Russia employs maritime drones, sabotage submarines, and suspicious commercial vessels to disrupt critical infrastructure. Every night, between the scattered lights of platforms and the heavy shadows of cargo ships, the maritime space appears less a commercial frontier and more a grey zone where silence can be shattered anytime by an alarm signal or distant explosion. The explosion of the Ukrainian reconnaissance ship Simferopol, attacked and sunk by Russia at the Danube mouths on the Chilia arm, just a few kilometres from Romanian territorial waters, should have accelerated finding a solution for identifying this type of threat. The moment when Russian drones penetrated deep into the Danube Delta to strike a Ukrainian vessel shows that, beyond press releases and maps, confrontation is already here, in the immediate vicinity of Romanian ports, testing the vigilance of naval forces and NATO borders (Cochino 2025).

Repeated incidents of Russian aerial drones penetrating Romanian airspace − including one that loitered for 50 minutes over NATO territory in September 2025 − illustrate the region's vulnerability to autonomous attack systems (Ministry of National Defence 2025). The fact that an uncrewed platform can remain nearly an hour over allied territory reveals not only an air defence technical problem, but also a deliberate testing of political tolerance limits − a cynical exercise through which Moscow measures both military reaction speed and NATO's diplomatic prudence. More recently, on January 14, 2026, the Chief of Defence stated that Romania neutralised 150 drifting mines since the conflict began, highlighting the persistent threat to commercial routes and energy platforms. Each mine recovered or controlled-detonated means a grain convoy can depart, a tanker can anchor safely, one more day where the regional economy functions without being brought to its knees by an "accidental" incident (The Maritime Executive 2025).

Taken together, these incidents do not merely illustrate Romania's vulnerabilities; they also provide a concrete problem-set against which a proactive, resilience-based response can be designed. Rather than remaining a passive consumer of security, Romania can use the lessons of the Black Sea drone campaign to articulate a positive agenda built around autonomous surveillance, layered defence of critical infrastructure, and regional industrial cooperation in the maritime domain.

Returning to the Neptun Deep project, it is particularly vulnerable due to its complex architecture: fixed deep-water platforms in waters 1,500 meters deep and 160 km of subsea pipelines. This project, developed in partnership by OMV Petrom and Romgaz, will position Romania as the largest natural gas producer in the European Union, with first production planned for 2027, with an estimated volume of approximately 100 billion cubic meters of natural gas. The initiative represents a direct challenge to Russia's energy dominance and a pillar for national energy security (OMV Petrom 2023). However, Romania's Exclusive Economic Zone (EEZ) in the Black Sea, where these critical platforms are located, does not benefit from the guarantees of Article 5 of the NATO Treaty, leaving energy infrastructure exposed to Russian threats in a context of intensified hybrid warfare. The Chief of the Defense Staff, General Gheorghiță Vlad, explicitly warned on January 13, 2026, that this economic zone is not adequately protected, emphasising that concerns extend beyond Neptun Deep to communication cables, underwater power lines, and essential trade routes (Ababei 2026).

The Romanian Naval Forces possess defence and surveillance capabilities, but these do not appear sufficient to counter complex threats in the Black Sea, where Russia demonstrates advanced capabilities in underwater warfare, naval drones, and "false flag" operations. Romania's National

Defence Strategy from November 2025 emphasises strengthening Black Sea regional ties to protect energy projects from Russian threats. The strategy identifies specific risks: naval drones, drifting mines, attacks on commercial routes, and underwater sabotage operations, insisting on developing autonomous naval capabilities as central to hybrid defence (Presidential Administration of Romania 2025). For Romania, protecting Neptun Deep and the entire EEZ at sustainable cost requires a multi-layered autonomous defence model inspired by Ukrainian lessons and NATO Baltic exercises: Layer 1 consists of persistent surveillance via light USVs similar to Magura, with 200-500 km autonomy, positioned around platforms for continuous patrolling, complemented by UUVs monitoring deep pipelines, detecting suspicious vibrations or approaching threats, with redundant communication via Starlink/Iris2 satellites or NATO systems ensuring defence data chains function even when adversaries strike communications infrastructure. Layer 2 features autonomous interceptors – drones with kinetic weapons designed to neutralise enemy vessels – equipped with reactive autonomous mines for immediate platform perimeter defence, with scaling to EEZ level requiring autonomous fleets of 50-100 units, minimising human loss risk. Layer 3 encompasses multi-domain integration (MDO) where aerial drones provide real-time surveillance and target designation, coordinated from shore platforms at Constanța and Mangalia.

Romania, Bulgaria, and Türkiye have demonstrated exemplary military partnership through the Black Sea Mine Countermeasures Group (MCM BS TG), with rotating command transitioned on January 7, 2026. This partnership could expand to economic-technological cooperation for developing regional maritime drone production capacity, moving from operational logic to industrial-strategic logic (Presidential Administration of Romania 2025). This formula leverages complementarity between Turkish expertise in unmanned vehicles such as ULAQ and Romanian industrial infrastructure at Constanța-Mangalia shipyards. A strategic agreement could establish joint production lines capable of producing 50-100 USVs annually, equipped with underwater threat detection sensors, redundant communications, and kinetic weapons. Regional production could also support Ukraine's economic-military effort, creating a Black Sea security ecosystem where technology and experience flow bidirectionally. Financing would combine anticipated Neptun Deep revenues with EU and NATO funding, ensuring rapid operationalisation through integration into multinational exercises such as Sea Shield. Thus, the same energy infrastructure Russia attempts to turn into vulnerability becomes a source of funding for an autonomous maritime protection architecture.

Conclusions

Facing the paradigm shift in the maritime battlespace by the historical review of technological disruptions at sea that shows – naval drones are not just another weapon, but a system that reshapes how power is projected and how resilience is built in the maritime domain. Just as submarines and carrier aviation redistributed combat power in previous eras, USVs now redistribute it horizontally across more numerous, cheaper and expendable platforms, forcing navies to rethink fleet design, survivability and deterrence in semi-enclosed seas.

The Black Sea case study demonstrates that a state deprived of a conventional fleet can, through systematic employment of naval drones, impose disproportionate costs on a superior navy, break blockades and gradually erode an opponent's freedom of action. The parallels drawn with the Baltic Sea and the Taiwan Strait indicate that constrained maritime theatres are especially favourable to such asymmetric strategies, and that coastal states and alliances must anticipate saturation attacks against critical infrastructure, not merely react after the fact.

The paper proposes a three-layer autonomous defence architecture composed of: a persistent surveillance layer of USVs and UUVs around platforms and pipelines; an active interception and close-in protection layer of autonomous interceptors and reactive mines; and a multi-domain integration layer linking maritime drones with aerial and land-based systems in a unified command-and-control framework. This model is the main result of the analysis and shows how Romania can obtain sustainable protection levels by exploiting the same cost asymmetries that make drones attractive to attackers.

The examination of existing regional initiatives and industrial capacities suggests that the proposed architecture is implementable through a coherent program of capability development and cooperation with Türkiye and Bulgaria, backed by Neptun Deep revenues and EU/NATO funding. A regional production and operational framework generating dozens of USVs per year would move Romania from vulnerable periphery to active security provider in the Black Sea and would offer a transferable model for other semi-enclosed theatres. In this sense, naval drones emerge not only as a disruptive threat but also as an instrument through which Romania and its allies can strengthen Euro-Atlantic resilience at sea.

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