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Russia-Ukraine War in Black Sea: Analysing the Employment of Unmanned Combat Systems by Ukraine

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Abstract

The article examines the strategic dynamics of the Russia-Ukraine conflict in the Black Sea, focusing on the transforming conduct of naval warfare. The employment of unmanned combat systems by Ukraine in Black Sea represents a strategic innovation that could redefine future naval warfare. This conflict serves as a crucial case study in how smaller nations can utilise technology to counterbalance larger powers in the maritime domain. To better understand the conventional disparity between Russian Black Sea Fleet (BSF) and Ukrainian Navy, the article provides a pre-war comparative analysis of naval vessels operated by both forces. Later, it gives brief overview of objectives which Moscow wanted to achieve in Black Sea in the opening days of conflict. Later the article provides a periodic recap of major incidents that have taken place in the Black Sea conflict till August 2024. The overview highlights approximately all major naval losses suffered by both naval forces. Particularly, attrition losses suffered by Black Sea Fleet against Ukrainian unmanned combat aerial vehicles (UCAV) like TB-02 and kamikaze unmanned surface vehicles (USVs) have been accounted. The article underscores the employment tactics of unmanned assets by Ukraine and how Russia has failed to effectively counter such threats despite conventional superiority in traditional sense. Furthermore, it explores how such systems will evolve in future conflicts and will reshape the conduct of future naval warfare.

Key Words: *Black Sea Fleet, Ukrainian Navy, Unmanned Combat Aerial Vehicles (UCAVs), TB-02, Kamikaze Unmanned Surface Vehicles (USVs).*

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Introduction

Covering an area of 436,402 square kilometers, the Black Sea is an inland sea located at the southeastern flank of Europe (Black Sea Geography, 2024). With relatively enclosed geography with limited outlets, it is surrounded by six countries: Turkey, Bulgaria, Romania, Ukraine, Russia, and Georgia. Black Sea is connected to the Mediterranean Sea through the Straits of Bosporus and the Dardanelles, making it a crucial maritime gateway between South-Eastern Europe, North Africa, and Asia.

Figure 1: Black Sea Map (Britannica, 2024).

Historically, Black Sea has been a competing ground for NATO and Soviet Union. This competition still persists in modern day power politics between Russia and NATO. For NATO, Black Sea offers a maritime buffer against Russia's potential expansion thus playing important role for maintaining stability in Eastern Europe and the Caucasus region (Toucas, 2017). With balanced military presence in Black Sea, NATO sought to maintain regional balance of power, deter Russia's aggression while avoiding risks of military escalation. This approach of NATO,

however, failed to deter Russia's invasion on Ukraine. Black Sea conflict serves as a critical case study for exploring the opportunities presented by unmanned combat systems in maritime domain. This article will explore how Ukraine's use of unmanned combat systems (UCS has influenced the conflict by serving as a viable counterbalance to Russia's naval superiority. Besides discussing Russia's military objectives and conflict progression in Black Sea, this research seeks to address key questions including: How has Ukraine employed unmanned combat systems in the Black Sea? What limitations of Russian military have been observed as far as countering Ukraine's asymmetric tactics in Black Sea is concerned? And how these systems will evolve further and shape the conduct of future naval warfare?

The argument put forth is that Ukraine's use of unmanned combat systems has shifted the traditional naval balance of power in Black Sea. The article will argue that the employment of unmanned systems has created nascent opportunities for sea denial and precision strikes, which Russia has struggled to counter effectively. The article will rely on qualitative data analysis, and will utilize data collected through recent research articles, analytical pieces, military reports and open-source intelligence (OSINT) to assess the effectiveness of Ukraine's unmanned systems. This research aims to contribute to the broader discourse on modern naval warfare and the role of unmanned systems in reshaping future conflicts.

Russia-Ukraine Naval Comparison in Black Sea

The Russian Navy, divided into four fleets (Northern Fleet, Pacific Fleet, Black Sea Fleet, and Baltic Fleet) and one flotilla in Caspian Sea, ranks among the largest in the world. Although much of its fleet dates back to the Soviet era, it remains sufficiently capable of carrying out both offensive and defensive operations in territorial and offshore waters. Pre-conflict Russian Black Sea Fleet comprised a mix of surface combatants – including flagship *Moskva* cruiser, submarines, amphibious ships, and auxiliary vessels. Considering the regional strategic dynamics, the fleet was specifically designed for amphibious operations and local sea-control. The Head Quarters of fleet is stationed in Sevastopol, Crimea (Delanoe, 2019).

During the Crimean crisis, Russia captured the majority of Ukraine's surface fleet docked in Sevastopol and about 75% naval personnel swore allegiance to Moscow leaving Ukraine's naval presence in the Black Sea nearly nonexistent (Annati, 2023). In compensate this significant loss, Kyiv sought to rebuild its naval capabilities by signing agreements with Turkey for two

Milgem-class corvettes (with option of two more) and TB-02 unmanned combat aerial vehicles (UCAVs) (Vavasseur, 2020). The TB-02s, equipped with micro-munitions, began arriving in 2021 (Ozberk, 2021). Meanwhile both corvettes, configured according to Ukraine's requirements, are currently conducting sea trials in Turkey (Ozberk, 2024).

At the time of Russian invasion, Ukrainian Navy comprised of a *Krivak-III* class frigate – named *Hetman Sagaidachnyy*, few gunboats and auxiliary vessels. *Hetman Sagaidachnyy,* was scuttled to avoid its capture by Russian forces (Janes, 2022). It is worth noting that majority of remaining Ukrainian naval vessels were captured by Russian forces on 14 March 2022. Comparative overview of Russia's Black Sea Fleet and Ukrainian Navy is as follows:

Naval Assets	**Russian Black Sea Fleet**	**Ukrainian Navy Fleet**
Aircraft Carrier (CV)	0	0
Cruisers (CGs)	1	0
Destroyers (DDGs)	0	0
Frigates (FFGs)	5	1
Corvettes (FFLs)	8	0
Anti-Submarine Crafts (ASW-C)	6	0
Fast Attack Craft Missile (FACM)	5	0
Patrol Ships (PB)	3	11
Mine Countermeasure Vessels (MCMV)	10	1
Landing Ships/Crafts (LSTs)	10	2
Nuclear Submarines (SSBN/SSGN/SSN)	0	0
Conventional Submarines (SSK)	6	0

Table 1: Pre-conflict Fleet Distribution of Russian Black Sea Fleet and Ukrainian Navy in 2022 (Hackett, 2022).

Russian War Objectives

On 24 February 2022, Russia launched multi-front invasion on Ukraine (Zinets, 2022). Russian ground forces penetrated from four different directions: Northern front from Belarus towards capital Kyiv; North-Eastern front from Belgorod towards Kharkiv; Eastern front into Donbas region; and Southern front from Crimea across the coastal belt towards Odessa in West

and Mariupol in East. The offense pattern suggested that Russia wanted to swiftly pierce through Ukrainian defenses and seize key population centers of Ukraine – particularly Kyiv. This would have allowed Moscow to overthrow current pro-EU regime and replace it with pro-Russian government. Considering the force disparity, common assumption was that Moscow will prevail and government in Kyiv will disintegrate within a week. However, stiff Ukrainian resistance, supported by NATO, not only halted Russian invasion, but forced it to retreat from various fronts.

In Black Sea it was also anticipated that Russian Black Sea Fleet will easily establish sea-control, impose naval blockade of Ukraine, and open extra front across Ukrainian coast by launching amphibious attacks on cities of Odessa and Mykolaiv (Delanoe, 2024). The successfully capturing of these regions would have allowed Russia to undertake deeper exertion to cut-off Ukrainian connectivity with Black Sea. This plan, however, also failed in initial stages. Russian Black Sea Fleet, despite all theoretical naval superiority over Ukrainian counterpart, failed to live up to its reputation.

Black Sea Conflict Overview

After invasion, the first military strategic initiative secured by Russian Navy was capturing of Snake Island (Benecki, 2022). By 28 February, Turkey had closed the Bosporus and Dardanelles straits for naval traffic essentially blockading Black Sea (Mongilio, 2022). Throughout month of March Russian warships bombarded Ukrainian coastline off Odessa but didn't attempt any amphibious operation. Despite overwhelming force disparity, Ukraine successfully employed asymmetric tactics to challenges Russia's naval superiority in Black Sea. On 24 March 2022, a Russian Alligator-class landing ship called *Saratov* was destroyed by Ukrainian *Tochka-U* tactical ballistic missile. The attack took place when ship was docked at Berdyansk and also caused damage to nearby vessels (Shammas, 2022).

The attack compelled Russia to rely on Sevastopol naval base for naval operations to keep fleet out of Ukrainian missiles range. The most promising success was achieved on 13 April 2022 when *Moskva* missile-cruiser, the flag ship of Russian Black Sea Fleet, sank after getting struck by two shore-launched Neptune cruise missiles (Beaumont, 2022). It's now known that U.S. provided predictive intelligence above cruiser movement using P-8 Poseidon Maritime Patrol Aircraft (MPA) operating close to Black Sea (Cooper, 2022). The information was further

supported by real-time intelligence provided by TB-02 drone (Hambling, 2022). Sinking of *Moskva* was not only a major psychological blow to Moscow, but also significantly degraded combat potential of Black Sea Fleet. Equipped with 64 S-300F long-range surface-to-air missiles, *Moskva* was key Russian asset for establishing airspace denial zone over Black Sea. It's sinking provided much needed space to Ukraine for employing airpower – particularly drones - for combat operations in Black Sea.

Following *Moskva* demise, Russian military installations at Snake Island came under repeated attacks by Ukrainian TB-02 UCAVs, forcing Russia to relinquish Snake Island by the end of June of following year (Roblin, 2022). Beside important ISR asset (intelligence, surveillance, and reconnaissance), TB-02 was also used successfully by Ukraine for direct targeting of Russian combat vessels including Raptor class patrol boats, Serena class landing ship (AFP, 2022) and allegedly even a Buyan-M class missile corvette (GDC, 2022). On 17 June, a pair of Harpoon missiles launched from coast sank *Vasily Bekh* rescue-tug boat – making second kill for coastal missile system (Brown, 2022). By end of June, Ukraine has successfully sunk *Moskva* cruiser, amphibious warships, and several patrol vessels thereby undermining Russia's ability to mount attack on Ukraine's western coast.

For next couple of months, Ukraine avoided any further attacks and Russia re-aligned itself for developing countermeasures against Ukrainian aerial drones and missiles. On 29 October 2022, a large-scale formation comprising of nine aerial suicide drones and seven kamikaze unmanned surface vehicles (USVs) attacked Russian Black Sea Fleet docked at Sevastopol (Lister, 2022). Although Russian officials claimed that attack was successfully repelled. But OSINT suggested that a *Natya* class minesweeper and *Admiral Makarov* guided-missile frigate were damaged by kamikaze USVs (Harding, 2022). The coordinated attack was first of its kind and redefined the employment methodology of unmanned systems in modern naval warfare. By this point, Russia had drastically slowed down operations in Black Sea and decided to retain defensive position in harbor. This led to an operational stand-still in Black Sea for more than half a year.

On 23 May 2023, Russian intelligence gathering ship, named *Ivan Khurs,* was damaged when it was ambushed by three kamikaze USVs (Newdick, 2023). In a major night raid at Sevastopol on 13 September 2023 two landing ships were severely damaged and a Kilo class hunter-killer submarine was wrecked beyond repair (MWM, 2023). The attack was conducted by

Ukrainian Su-24 fighter aircraft using Storm-shadow cruise missiles (Axe, 2023). A day later, *Sergey Kotov* patrol ship was damaged by suicide drone boat, and was later sunk in another suicide drone boat attack (Talmazan, 2024). On November 2023, a volley of cruise missiles launched by Ukraine struck *Zalyv* Shipbuilding yard in Kerch, severely damaging a newly built *Karakurt* class missile corvette (Starkova, 2023). A month later, Ukrainian Air Force successfully destroyed *Novocherkassk* landing ship near Southern Crimea using air-launched cruise missiles (Osborn A. , 2023). So far in year 2024, Ukraine has used kamikaze drone boats with remarkable success and sank a *Tarantul* class missile corvette, (Altman, 2024) a *Ropucha-I* class landing ship, (Kirby, 2024) and a patrol boat. As far as sea action is concerned, there are two known incidents in which Russia has used lancet kamikaze drone to destroy Ukrainian patrol boats (Altman, 2022).

According to Oryx database, 16 Russian warships have been destroyed and six have been damaged as of mid-August 2024. Unmanned systems have destroyed warships and damaged nine vessels. Usually smaller and nimble vessels have been sunk by aerial combat drones while bigger and slower warships have fell victims of kamikaze drone boats. Tabular overview of Russian Black Sea warships destroyed by various Ukrainian weapon systems is given below:

Warship and Weapon Types	**Cruiser**	**Frigate**	**Corvettes/ Patrol Ships**	**Patrol Boats**	**Landing Ships**	**Submarine**	**Total**
Short-Range Ballistic Missile	00	00	00	00	03	00	**03**
Coastal Cruise Missile System	01	00	01	00	00	00	**02**
Air Strike by Fighter Aircraft	00	00	01	00	00	01	**02**
TB-02 UCAVs	00	00	00	05	00	00	**05**
Suicide USVs	00	00	02	00	02	00	**04**
Grand Total	**01**	**00**	**04**	**05**	**05**	**01**	**16**

Table 2: List of Russian Warships destroyed by Ukraine (Oryx, 2024).

Exploring Employment of Unmanned Systems

The most eminent aspect of Russia-Ukraine war in Black Sea is wide scale adaptation of drones including; medium altitude and long endurance (MALE) combat drone, weaponized

commercial aerial drones, and kamikaze drone boats, in maritime domain. This has greatly undermined the Russia ability to exercise naval prowess in Black Sea. Brief description of each asset and its employment is discussed below.

The extensive employment of TB-02 UCAV in maritime domain has been undertaken by Ukraine for the first time. Being a mid-sized MALE combat drone, TB-02 carries only micro-munitions which are effective against small targets. It cannot carry anti-ship missiles. However, despite all technical limitations, TB-02 has emerged as valuable asset for Ukraine to challenge Russian dominance in Black Sea. In brief two employment approaches can be underscored. First, TB-02s were used for Intelligence, Surveillance, Target-Acquisition and Reconnaissance (ISTAR) role to force-multiply Ukraine's overall combat potential. Reportedly, TB-02 UCAV played important role in the sinking of *Moskva cruiser* by providing over-the-horizon (OTH) tracking capability and acting as crucial component of Ukrainian kill-chain. *Moskva* sinking and absence of Russian air power granted TB-02 UCAVs greater freedom of operation over the Black Sea. Similarly, Russian rescue tugboat *Vasily Bukh* was also sunk by harpoon missiles using assistance of TB-02.

Second, TB-02s were used to directly destroy sea-targets using guided munitions. Instead of directly engaging Russian warships equipped with potent air-defense system, like *Admiral Grigorovich* class frigates, TB-02s targeted smaller vessels like Raptor class assault boats and small landing vessels. By taking advantage of low radar-cross-section (RCS) and thermal signature, TB-02s have conducted successfully strikes against assets protected by air-defense systems. On Snake Island alone, TB-02s knocked out three air-defense systems, one helicopter on ground, and a command post (Sutton, 2022). Coupled with high-degree of automation, advanced surveillance systems, resilience against jammers, payload modularity, and ability to operate from dispersed locations, TB-02 has settled benchmarks as far as efficiency of aerial drones in naval warfare is concerned.

Another nascent development in Black Sea conflict is employment of loitering munitions and FPV (first-person view) drones to target naval installations and vessels. Loitering munitions are suicide drones with high-degree of automation which allows these drones to loiter above battlefield for extended duration and hit target with precision. The human input from launch to engagement is very limited and incorporation of a higher degree of autonomy allows these munitions to exploit vulnerabilities in the enemy's defenses and engage beyond visual line of

sight (BVLOS) and even over the horizon (OTH) targets with precision (Ibrahim, 2022). In contrast, FPV combat drones are suicide drones which are equipped with payload, are radio-controlled by human operator, who use live video feed from drone's onboard camera. (Milasauskas, 2024) Unlike traditional UCAVs, which act as a launch platform for weapons, loitering munitions and FPV combat drones are weapons themselves and carry integrated warhead.

Allegedly, kamikaze aerial drones were used by Ukraine in conjunction with suicide drone boats to target Sevastopol harbor on 29 October 2022. This combined attack formation successfully breached the harbor defenses and damaged two warships. The attack compelled Russia to beef-up the defense against this new type of threat. On 22 March of next year, Ukraine attempted similar attack formation against well-protected Sevastopol naval station. This time, however, all attacking drones were successfully intercepted by Russian defenses. Although Ukraine has used kamikaze aerial drones with remarkable success against land based targets. But the performance of Ukrainian suicide aerial drones in maritime domain has been mediocre at best. In contrast, Russia has been more innovative with usage of such drones in Black Sea. First ever kill of loitering munitions in naval warfare was achieved by Russian *Lancet* suicide drone against Ukrainian *Gyruza-M* patrol boat on 04 November 2022 (Ozberk, 2022). Similarly, FPV drone was used for defensive role for the first time by Russian forces. On 29 May, Russian sources released footage of Ukrainian suicide drone boat being hit by Russian FPV drone (Satam, 2024). The incident was practical demonstration of a much-anticipated tactic.

It's worth noting that use of loitering munitions and FPV drones in Black Sea have been rather limited. Unlike land-based operation, tracing targets in vastness of open seas is a very challenging undertaking. Thus, shore-launched, small and less-ranged suicide aerial drones have limited applicability. Albeit, near coastal areas and choke points these munitions can offer promising results. Beside range shortcoming, such munitions have limited payload due to size restriction which narrow down the targeting envelop to smaller vessels. Additionally, the efficiency of these munitions is questionable against warships protected by multi-layer defenses. Such warships can either be caught off-guard or a swarm tactics are needed to saturate warship defenses (Ibrahim, 2023). Aforementioned reasons elaborate why such munitions have been employed on comparatively limited scale in Black Sea conflict by both sides.

While discussing suicide drones, relatively successful use of weaponized-commercial drones by Ukraine also deserves consideration. Ukraine used weaponized cheap Chinese built Mugin-5 drones to target Black Sea Fleet headquarters in Sevastopol on August 2022 (Shcherbak, 2024). These commercial drones are readily available and can be configured for military use in large quantities. Although such drones have operational and structural limitations, particularly when pitched against warships, but for engaging coastal infrastructure such drones can have valuable contribution as attack platform as or decoys.

Perhaps the most eminent and highly featured weapon in Black Sea conflict is the armed unmanned surface vehicle (USVs) alternatively dubbed as suicide drone boat or kamikaze sea-drone. These drones are equipped with electro-optical device, radio antennae for remote-control, and are armed with explosive payload designed to detonate upon impact with target. The presence of antennae suggests that Ukrainian examples are remotely operated by human. However, such vessels can also be pre-programmed to operate more independently. Historically, explosive-laden boats have been used in limited capacity by navies and non-state actors. Usually such boats were either operated by wire-guidance mechanism or by were piloted by human operator - thus narrowing down their scope of operation (Roger, 2020). However, advancements in technology have reduced the human factors and have enhanced the level of autonomy. The war in Black Sea has showcased their true potential to evolve as potent anti-surface warfare (ASuW) asset in near future.

Ukraine's armed USVs are product of Black Sea conflict and have gradually evolved with lessons learnt from each attack. These suicide drone boats are small, fast, expendable and have low-profile making them a hard target to detect and intercept. These drones incorporate higher level of autonomy and usually rely on star-link connectivity for operation. At the same time, these drones are cheap, easy to build and employ commercial grade technologies which are easily accessible. The first prototype was developed in the summer of 2022. The first production version, called *Mykola*, was involved in attacks on Sevastopol during months of October and November in year 2022. This 5.5m long drone had operational range of 800kms and could carry payload of 200kg. By using commercial water-jet of jet-ski, *Mykola* achieves the max speed of 43knots. (Sutton, 2022). *Magura-V5* is the second generation armed USV and came to limelight when Russian Navy intelligence ship *Ivan Khurs* was attacked on 24 May 2023 far south of Crimea. This demonstrated *Magura-V5* capability to travel at longer ranges and target ships in

open seas. Compared with *Mykola, Magura-V5* has similar physical dimensions and max speed, but has longer range, carries bigger payload of 320kg, supports improved data-ink, and is equipped with superior electro-optical and infra-red sensor (Sutton, 2023).

The third generation, and currently the most capable armed USVs in Ukraine disposal are called *Sea Baby*. Made with reinforced hull, this drone boat can transverse rough sea and can strike surface vessels in the entire Black Sea. With 6m length, USV has more range (1,000kms), more speed (49 knots) and carries nearly a ton payload (850kg). Beside built-in explosive warhead, several new alternations of Sea Baby USVs have been developed. It can be additionally equipped with thermobaric rockets, grad rockets, supplementary fuel-tanks, and even a pair of R-73 Archer IR surface to air missile. The rockets are added to provide additional firepower to disrupt or destroy enemy defenses which can intercept this drone. Since Russia has been using helicopters to destroy these drones, therefore a pair of R-73 Archer missile was added to engage aerial threats (Sutton, 2024). As conflict will progress, its likely more advance versions of USVs will be developed by Ukraine.

Russian Limitations in Black Sea

Through-out Black Sea conflict, Russia has repeatedly showcased certain shortcomings which were successfully exploited by Ukraine. To begin with, Black Sea was never a focal point for Russian military command. Black Sea front was meant to deny Ukraine's maritime connectivity and mount amphibious assault on Ukrainian coasts to open additional front from South. As Russian army, which invaded Ukraine from multiple fronts, began to push back, more resources and focus were directed to sustain land fronts, leaving Black Sea Fleet exposed to Ukraine's asymmetric attacks.

Foremost limitation was the absence of Russian air-power over Black Sea. Presence of air-coverage would have allowed Russia to degrade Ukrainian efforts of deploying asymmetric operations. Additionally, employment of Russian fighter aircrafts in the Black Sea airspace would have denied TB-02 UCAV operations. Furthermore, Russia's airborne ISR assets, like Airborne Early Warning and Control (AEWSCs) aircrafts would have provided OTH situation awareness for Russian Navy. Sinking of *Moskva*, despite presence of multi-layer air-defense system, is attributed to element of surprise as cruiser was caught off-guard due to insufficient early warning and ISR capability– particularly against OTH threats (Axe, 2022).

Second, Russian Black Sea Fleet had limited air-defense capability at the time of invasion on Ukraine. With exception of *Moskva* missile-cruiser, no other warship of fleet was equipped with long-range air-defense missiles. The overwhelming dependency on *Moskva* backfired once the cruiser sank. It created a big void in Black Sea Fleet air-defense capability. Yes, two *Admiral Grigorovich* class frigates, equipped with *Shtil* medium-range air-defense missiles, were operational and one of the frigates, namely *Admiral Essen*, also shot down a TB-02 UCAV (Recognition, 2022). But only two frigates were inadequate to provide protective cover to other assets of Black Sea Fleet (Axe, 2022). This led to high attrition against Ukrainian drones. Rudimentary measures, like installation of land based Tor-M2 SAM system on patrol ship (Militarnyi, 2022), also couldn't deliver requisite results.

And finally, Russian high command gave no consideration to forthcoming threats despite clean intelligence, and continued to operate without taking necessary precautions. For example, Russia was aware of Neptune missile battery, yet *Moskva* continued to operate close to Snake Island within strike range of missile. Same mistake was repeated by *Vasily Bekh* rescue tug boat which was sailing in targeting envelop of newly delivered shore-based Harpoon missiles. Frequent losses of patrol boats against TB-02 UCAVs, is another example of incompetence and neglect displayed by Russian Black Sea command. Similarly, kamikaze USV was firstly spotted ashore and was reported by various open sources. Russia ignored the gravity of danger posed by this new form of threat and later paid the heavy price. Defensive measures like helicopters' patrols, physical barriers like floating booms and nets, and deceptive camouflage paint schemes have also proven inadequate to reliably safeguard Russian warships against suicide drone boats (Sutton, 2023).

Russia-Ukraine war in Black Sea has now entered into the phase of frozen conflict. With Bosporus and Dardanelles straits closed, Russia can no longer replenish its Black Sea Fleet with additional warships and submarines. Similarly, Ukraine neither has the capability to establish sea control in Black Sea due to absence of warships, nor it can acquire any major naval asset from foreign source. Kyiv will continue to focus on asymmetric tactics to deny freedom of operations to Russians in Black Sea. Meanwhile, primary focus and the bulk of resources of both antagonists are being directed towards land battles.

Unmanned Systems in Naval Warfare: Future Outlook

Russia-Ukraine war in Black Sea have paved way for innovative unmanned systems which once mature can shape the conduct of future naval warfare. These unmanned systems will provide low-cost low risk solution in complex battlespace. With integration of newer capabilities, unmanned systems will become more capable and operationally flexible in all domains of naval warfare. In future, besides providing inherent ISR duties, UAVs/UCAVs will be employed for stand-off strike missions, air-defense, ASuW, ASW operations, and other complex missions. Many modern examples like U.S. *MQ-25 Stingray* (Rogoway, 2024), China's WJ-700 (Osborn K. , 2021), and Turkey's *Akinci* (Sünnetci, 2024) are either being planned or already being equipped with anti-ship cruise missiles, loitering munitions, and similar guided weapons.

Enhanced autonomy and dynamic decision making capability will allow these unmanned systems to effectively operate in swarms and as loyal-wingman. Jet-powered UAVs/UCAVs, particularly with built-in stealth features, will further elevate the combat potential of these systems making them equivalent or even superior than manned-aircrafts. Such UAVs/UCAVs will likely be integrated into network-centric warfare systems, enabling seamless communication with other unmanned systems, surface ships, and submarines to execute complex multi-domain operations. Similar developments will be observed in the domain of loitering munitions. These munitions have low RCS and hovering capabilities which enable them to exploit enemy's defensive vulnerabilities. In future, loitering munitions are expected to become standard load-out of many naval vessels.

Low tonnage vessels, like fast attack crafts (FACs) and off-shore patrol vessels (OPVs), which cannot be equipped with cruise missile due to size limitations, can support loitering munitions for significant increment in firepower, strike precision and engagement range. Additionally, heavier vessels, like destroyers and frigates, can be equipped with loitering munitions for improving operational flexibility. These munitions bridge the gap between deck guns and cruise missiles, offering a middle ground in both range and firepower. They are particularly effective against targets that are too small for cruise missiles or beyond the reach of guns. Naval aviation and sub-surface assets can also gain advantages from specialized versions of these loitering munitions. In swarms, these munitions can overwhelm even layered defenses and can offer remarkable operational flexibility when employed with varying payloads, like

warheads, jammers, and decoys. Future holds bright prospects for kamikaze drone boats also. Due to their small size, these drones have restricted range and endurance, which degrade their usefulness particularly in open seas. Effective use of air-power, electronic warfare (EW), and even anti-surface warfare (ASuW) can disrupt USV operations.

Despite these limitations, drone boats are likely to impart major impact in the conduct of naval warfare in future. Technological advancements – like higher degree of autonomy, and refinement in employment tactics, can enhance the operational flexibility of USVs in future. (Ibrahim, 2023). Supervised autonomous drone boats will be able to operate in swarms and in conjunction with other manned-unmanned systems for overwhelming enemy defenses (Ibrahim, 2024). In future, drone mother-ships may be used for employing variety of USVs for conducting wide spectrum of naval operations in closed as well as open seas (Harper, 2023). Traditional naval war fighting strategies are being challenged by innovative asymmetric tactics involving employment of unmanned systems. By effectively using unmanned combat systems, Ukraine has disrupted Russia's naval superiority in Black Sea. As these technologies continue to evolve, they are likely to become even more integral to naval strategy, particularly for nations facing conventional power asymmetries in naval domain.

Conclusion

The ongoing Black Sea conflict, besides exposing limitations of Russia's naval might, has also underscored the growing significance of unmanned combat systems in modern naval warfare. Despite being outmatched in traditional naval power, Ukraine has successfully employed UAVs/UCAVs, weaponized commercial drones, and kamikaze sea drones to conduct sea-denial operations and target high-value Russian naval assets, thereby disrupting Russian naval operations in Black Sea. For Ukraine, continued investment and evolution of these systems will be crucial to maintaining its defense against Russian naval forces. Conversely, Russia will need to adapt by developing effective countermeasures and enhancing its own unmanned capabilities to maintain dominance in the Black Sea. In nutshell, the Black Sea Conflict has demonstrated that the future of naval warfare is increasingly driven by unmanned systems. As technology will evolve further, more capable and superior unmanned systems will emerge which will eventually impart redefining impact on the conduct of future naval warfare.

Disclosure Statement

No potential conflict of interest was reported by the author.

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