Sea Drones in Maritime Warfare: The Ukraine Experience

Vice Admiral AK Chawla, PVSM, AVSM, NM, VSM, PhD (Retd)[@]

Abstract

The ongoing invasion of Ukraine has an important maritime dimension in which, for the first time in maritime history, sea drones have demonstrated the immense potential they possess in maritime warfare. This article analyses the reasons for the success of sea drones, as well as their limitations. It surmises that while sea drones are not a 'Silver Bullet' that can replace the existing arsenal of naval weapons, or indeed render warships obsolete, they represent a new and potent option that, in coming years will attain greater potency, perhaps even becoming the weapon of choice in maritime warfare.

Introduction

The maritime battlespace of the Russo-Ukrainian War is unique in many ways, being fought entirely in the landlocked Black Sea and the Sea of Azov, rather than the open oceans. The only maritime exit from the Black Sea is through the narrow Straits of Bosporus and the Dardanelles, both of which lie entirely within the territorial waters of Turkey. Under the Montreux Convention of 1936, Turkey is empowered to control the access of warships through the two Straits in wartime, and if Turkey is not involved in the conflict, warships of nations at war may not pass through them, except when returning to their base. Lying on the northwestern coast of the Black Sea and the Sea of Azov, with the Crimean Peninsula jutting deep into the sea, Ukraine dominates the region. On Ukraine's coastline are 18 major and minor ports,

[@]**Vice Admiral AK Chawla, PVSM, AVSM, NM, VSM, PhD (Retd)** superannuated from the Indian Navy on 30 Nov 2021 after serving as the Flag Officer Commanding-in-Chief of the Southern Command. Throughout his career, he commanded five warships, including the aircraft carrier INS Viraat, and led the Indian Navy's Western Fleet. A distinguished maritime thinker, he earned his PhD on 'The Role of Maritime Power in China's Grand Strategy', which is set to be published by Routledge. Currently, he serves as an Adjunct Professor at Rashtriya Raksha University and is involved with various defence think tanks and social initiatives.

which are its economic lifeline. Russia occupies the northeastern coast of the Black Sea and the Sea of Azov. The other littoral states of the Black Sea include Georgia, Turkey, Bulgaria, and Romania.

Map of the Black Sea and the Sea of Azov

The Crimean Peninsula, annexed by Russia in 2014, contains the vital naval base of Sevastopol, which was home to a large Soviet naval base and is now the home port of Russia's Black Sea Fleet. The ports in the Black Sea are crucial for Russia as they provide access to the Mediterranean, and through that, to the Atlantic and Indian Oceans. Without this access, the Russian Navy and their merchant marine would have to transit thousands of nautical miles around Europe, or through East and Southeast Asia, to reach these waters. Access to the Mediterranean makes Russia a major maritime player in the Levant, the Middle East, North Africa and Southern Europe. Russia's naval bases in the Black Sea also support Russian forces in Syria, including its naval facility at Tartus.

The War Thus Far and the Current Situation

While the overall aim of Russia's invasion of Ukraine was to ensure that it remained within the sphere of Russian influence, the maritime aims of the invasion were evidently threefold. The first and most

obvious aim was to destroy the Ukrainian Navy and achieve sea control in the Sea of Azov and the northwestern Black Sea. The second aim was to cripple Ukraine's economy by choking its maritime trade. This would also prevent any reinforcements of weapons, stores, supplies, and personnel from reaching Ukraine by sea. The third aim was to support the operations carried out by land forces in capturing the southern Ukrainian provinces of Zaporizhia and Kherson. This was primarily to ensure a land bridge to Russia to Crimea, instead of depending on the tenuous connection over the bridge at the Kerch Strait, with the secondary aim of creating a land bridge to Moldova. The fourth aim was to strengthen Russia's strategic access to the Mediterranean, thereby retaining Russia's influence in a critical geographical region.

In the first few months of the war, this strategy worked well. After the invasion commenced on 22 Feb 2022, most Ukrainian Navy units were lost or captured, with some scuttled by the Ukrainians themselves to prevent them from falling into Russian hands. As such, 75.0 per cent of the Ukrainian Navy had fallen into Russian hands after the annexation of Crimea in 2014. A list of Ukrainian ships (Navy and Sea Guard) damaged or sunk by Russian forces, or scuttled by the Ukrainians (Table 1), indicates the scale of devastation suffered by Ukraine.

Ser No	Name of Ship	Type	Remarks
1	Hetman Sahaidachny	Frigate	Krivak-III-class, Flag ship of Ukraine Navy scuttled by Ukrainian forces in Mykolaiv to prevent capture by Russia, 03 Mar 2022
2	Sloviansk	Patrol Boat	Island-class, sunk by Russian Kh-31 air-to-surface missile off Odesa, 03 Mar 2022
3	Henichesk	Minesweeper	Yevgenya-class, sunk with Sloviansk, 03 Mar 2022
4	Akkerman Vyshhorod, Kremenchu, Lubny +1	Gunboats	5 Gyurza-M-class gunboats captured by Russian forces during the fall of Berdiansk (14 Mar 2022) and siege of Mariupol (04 Nov 2022). One boat damaged by Russian ZALA Lancet loitering munition near Ochakiv

Ser No	Name of Ship	Type	Remarks
5	Pryluky	Missile Boat	Matka-class, captured by Russian forces at Berdiansk, 14 Mar 2022
6	Zhuk-class	Patrol Boat	Captured by Russian forces at Berdiansk, 14 Mar 2022
7	Yevgenya-class	Minesweeper	Captured by Russian forces, Berdiansk, 14 Mar 2022
8	Yuri Olefirenko	Landing Ship	Polnocny-class, Captured by Russian forces, Berdiansk, 14 Mar 2022
9	Onadatra-class	Landing Craft	Captured by Russian forces, Berdiansk, 14 Mar 2022
10	Korets	Sea-going Tug	Sorum-class, converted to patrol vessel, captured by Russian forces, Berdiansk, 14 Mar 2022
11	Pereyaslav	Reconnaiss-ance Ship	Project 1824, Damaged by gunfire on Dnieper River, 30 Mar 2022
12	Donbas	Command ship	Destroyed during siege of Mariupol, 06 Apr 2022
13	Dmitry Chubar	Hydrographic Boat	Rubin-class, captured by Russian forces during siege of Mariupol, 24 Feb 2022
14	Stanislav	Fast Assault Craft	Two Centaur-LK-class, lost during counterattack on Snake Island, 29 Nov 2022 and 17 Apr 2023
15	Unmanned Surface Vehicles (USVs)	Attack/ Recce	16-24 USVs destroyed in attacks on Russian forces/ at various bases
16	PO-2-class	Gunboat	Destroyed by ZALA Lancet drone, 17 Apr 2023
17	Vinnytsia	Auxiliary Vessel	Decommissioned Grisha-II-class ASW corvette, ship scuttled at moorings in Ochakiv, 10 Jun 2022
18	Ternopil	ASW corvette	Grisha-class, captured by Russia and sunk during practice firing by SS-N-2 missile fired by Tarantul III missile boat, *Ivanovets* in north-western Black Sea, 20 Jul 2023

Ukrainian Sea Guard Vessels

Ser No	Name of Ship	Type	Remarks
1	Zhuk-class	Patrol Boats	Four patrol boats destroyed/ captured during siege of Mariupol
2	Lakan-class	Patrol cutters	Six captured during siege of Mariupol

Ser No	Name of Ship	Type	Remarks
3	UMS-1000-class	Patrol cutters	Four captured during siege of Mariupol/at Berdiansk
4	BG-732	Motor yacht	Adamant-class, captured at Berdiansk
5	Donbas	Patrol boat	Stenka-class, sunk during Siege of Mariupol

Table 1 - Ukrainian Warships Sunk/Captured/Damaged by Russia or Scuttled by Ukraine

Immediately after the commencement of the war, Ukraine had requested Turkey to exercise its rights under the Montreux Convention and prevent additional Russian warships from entering the Black Sea. Anticipating this, Russia had reinforced the Black Sea Fleet before the invasion began with 16 units from other fleets in the Baltic, North Sea and the Pacific. These units included missile-armed ships and landing ships. On 27 Feb 2022, Turkey complied with Ukraine's request by declaring that since a state of war existed between Russia and Ukraine, the Straits of Bosporus were now closed for transit for all warships. The enforcement of the Montreux Convention implied that no additional Russian Navy units could enter the Black Sea. However, additional units were not required, as, in the absence of any credible opposition at sea, the Russian Navy was successful in enforcing complete sea control over the northern portion of the Black Sea within a week of the commencement of the war. The first maritime aim was, therefore, achieved very quickly.

To achieve its second aim, Russia declared a de-facto blockade off the Ukrainian coast by 'Suspending' navigation in the Sea of Azov and the northwestern Black Sea (45° 21' North) citing the conduct of 'Anti-terrorist' operations as the reason for doing so. The Black Sea Fleet also blockaded the Kerch Strait, which connects the Sea of Azov to the Black Sea. The exception to this restriction was the UN-brokered grain deal, under which Ukraine was allowed to export grain, related foodstuffs and fertilisers through three Ukrainian ports, using neutral shipping transiting along a designated maritime humanitarian corridor. However, this deal was rescinded by Russia on 17 Jul 2023. To ensure its seriousness in implementing the blockade, the Russian Navy did not hesitate to use deadly force against merchant ships using

Ukrainian ports or carrying Ukrainian cargo. For example, in the early stages of the war, two merchant ships, a Panama-flagged bulk carrier, the Namura Queen, and a Moldova-flagged bunker tanker, Millennium Spirit, were hit by Russian missiles and set ablaze. This ensured the complete stoppage of all merchant traffic to and from Ukraine, with serious effects on its economy and warfighting capability.

The third aim, to support the land operations, also progressed smoothly in the initial stage of the war. Black Sea Fleet ships were utilised to attack land targets using Kalibr missiles on board their Buyan-M corvettes, Admiral Grigorovich-class frigates, Project 2022160 class patrol ships and improved Kilo-class submarines. The most publicised action by the Russian Navy was the attack and capture of Ukraine's Snake Island, located 50 nautical miles south of Odessa, very close to the Romanian coast. This action was undertaken by the flagship of the Black Sea Fleet, the Slava-class cruiser Moskva and a Project 2022160-class patrol ship, with the Russian Marines executing the actual landing on the island. The Marines also carried out an amphibious attack 30 miles south of the Ukrainian port of Mariupol, on the Sea of Azov, in conjunction with another pincer from the Crimean Peninsula by land forces, hastening its surrender. The capture of vital Ukrainian ports of Mariupol, Berdiansk and Mykolaiv dealt a body blow to the Ukrainian Navy and boosted the bases available for operational use to the Russian Navy. The support provided by the Russian Navy also facilitated in the quick capture of Zaporizhia and Kherson provinces (including its capital, Kherson City), although the aim of creating a land corridor to Moldova by capturing Ukrainian territory further west of the Dnieper River was not achieved.

With the destruction of the Ukrainian Navy and the achievement of sea control in the northwestern Black Sea and the Sea of Azov, the fourth aim of ensuring strategic access to the Mediterranean also appeared to have been achieved.

The Tide Turns

However, the tide turned very quickly against the Russians in the maritime theatre. Bereft of conventional naval forces and facing a relentless squeeze on its economic lifeline, Ukraine crafted a new strategy to counter Russia's naval dominance, which was based on the use of drones, shore-based and air-launched anti-ship

missiles, short-range ballistic missiles, and tactical land attack missiles, as also a few raids by the Special Forces. The absence of any Ukrainian warships meant that Russian forces were primarily engaged in targeting value assets ashore, which required them to operate within land attack missile range of the Ukrainian shore. This, and the geographical circumstances of the Black Sea, where there is limited sea room for Russia's blue water forces to manoeuvre, made them vulnerable to counterattack. The third factor exploited by Ukraine was the proximity of the Black Sea Fleet's headquarters at Sevastopol and other naval bases in Crimea to Ukrainian land and air-based missiles and drones. The limited presence of neutral shipping in the maritime theatre due to Russia's blockade, considerably eased Ukraine's targeting challenges.

The turning point in the maritime war was the sinking of Russia's Black Sea Fleet flagship, and the symbol of Russia's naval power, the *Moskva*, by two Neptune anti-ship missiles launched from Ukrainian fighter aircraft on 14 Apr 2022. Operating in proximity to Odesa, the Moskva's air defence systems were slow in locking on to the two missiles due to the lack of reaction time, having been confused by several other air targets in the vicinity which included both aircraft and drones. A fortuitous hit on the cruiser's magazine led to the ship being abandoned with considerable loss of life. The ship finally sank while being towed to harbour for repairs the next day.

Ukraine began its unmanned vehicle offensive with the use of Turkish Bayraktar TB2 drones to attack small Russian warships operating close to Odesa in May 2022 and was immediately successful in sinking six small naval vessels off Snake Island. The pressure at sea forced Russian forces to withdraw from Snake Island on 30 Jun 2022 and subsequently from the west bank of the Dnieper River on 11 Nov 2022. In Oct 2022, Ukraine also launched a 'Swarm' attack by both sea and air drones on Sevastopol harbour, which resulted in damage to a minesweeper and a frigate, as also some harbour infrastructure. Repeated attacks with deadly effect on Sevastopol also led to the Black Sea Fleet moving its headquarters to Novorossiysk and ships to Russian bases in the eastern part of the Black Sea. However, Ukrainian Magura V5 sea drones targeted warships off these ports as well with an attack on the Olenagorsky Gornyak, a large landing ship, off Novorossiysk on 04 Aug 2023. Severely damaged in the attack, it was the first major warship put out of action by sea drones. In

subsequent months, six other warships were sunk at sea by Magura V5 sea drones, two patrol vessels, one corvette, a large landing ship, one patrol boat and an ocean-going tug. In addition, an intelligence gathering ship was damaged. Ukrainian Sea Baby Sea drones have also been used to lay mines off Russian harbours, which are reported to have damaged two warships and two auxiliary vessels. They have also been used in attacks on the Kerch Bridge with limited success.

Over the past 30 months of the war, more than 30.0 per cent of the force levels that the Black Sea Fleet's force levels at the start of the conflict have been either sunk or severely damaged, which has considerably diminished Russian dominance in the Black Sea, though not in the Sea of Azov. The list of Russian ships sunk/damaged by conventional weapons is provided in Table 2, while the list of Russian ships sunk/damaged by Ukrainian drones is given in Table 3.

Ser No	Ship/ Tonnage	Type	Remarks
1	Saratov	Landing Ship	Alligator-class, seriously damaged by Tochka-U ballistic missile and scuttled, Berdiansk, 24 Mar 2022
2	Moskva	Cruiser	Black Sea Fleet flag ship hit by 2 Neptune anti-ship missiles and sunk off Sevastopol, 14 Apr 2022
3	Vasily Bekh	Rescue Tug	Sunk by 2 Harpoon anti-ship missiles off Snake Island, 17 Jun 2022
4	Veliky Ustyug	Corvette	Buyan-M-class, damaged by BM-21 Grad rocket system in the Azov Sea, 17 Jun 2022
5	Admiral Makarov	Frigate	Black Sea Fleet flag ship damaged in Sevastopol harbour, 30 Oct 2022
6	Minsk	Landing Ship	Destroyed in dry dock in Sevastopol by Storm Shadow missiles fired by Su-34s, 13 Sep 2023
7	*Rostov-on-Don*	Submarine	Kilo-class submarine dry-docked in Sevastopol destroyed by Storm Shadow missiles fired by Su-34s, 13 Sep 2023

Ser No	Ship/ Tonnage	Type	Remarks
8	Askold	Corvette	Karakurt-class destroyed by cruise missiles, Zalyv Shipbuilding yard, Kerch, Crimea, 04 Nov 2023
9	Novocherkask	Landing Ship (Large)	Destroyed in Feodosia harbour, southern Crimea, by air launched cruise missiles. Being loaded with munitions, 78 crew members also killed, 26 Dec 2023
10	Universal Trawling System-150	Mine-sweeper	Converted to a training ship, former T-43-class minesweeper sunk due to explosion of Novocherkassk, Feodosia harbour, 26 Dec 2023
11	Ivan Khurs	Intelligence ship	Yuri Ivanov-class, damaged by missile strike in Sevastopol harbour, 23-24 Mar 2024
12	Tsiklon	Corvette	Karakurt-class destroyed by cruise missile strike in Sevastopol harbour, 21 May 2024

Table 2 - List of Russian Warships Sunk/Damaged by Ukrainian Conventional Weapons

Ser No	Ship/ Tonnage	Type	Remarks
1	Saturn	Tug Boat	Sunk by Magura V5 sea drones in port of Chornomorsk, Crimea, 06 Jun 2024
2	Mangust-class	Patrol vessel	Sunk by Magura V5 sea drones off Crimea, 06 May 2024
3	Sergey Kotov	Patrol Ship	Project 2022160, attacked by drones and damaged 14 Sep 2023, again attacked by Magura V5 drones off Kerch Strait and sunk, 05 Mar 2024
4	Tsezar Kunikov	Landing Ship, Tank (Large) [LST (L)]	Ropucha-I-class, sunk by Magura V5 drones off Crimea, 14 Feb 2024
5	Ivanovets	Corvette	Tarantul-class, sunk by Magura V5 sea drones in Donuzlav Bay, western Crimea, 01 Feb 2024
6	Tunets-class	Patrol Boat	Project 2022160, sunk by 3 Bayraktar TB2 drones in Black Sea, 13 Sep 2023

Ser No	Ship/ Tonnage	Type	Remarks
7	Ivan Khurs	Intelligence ship	Yuri Ivanov-class, damaged by sea drones in Black Sea, 24 May 2023
8	Raptor-class	Patrol Boat	Sunk by drones in Black Sea, 13 Sep 2023
9	Admiral Makarov	Frigate	Black Sea Fleet flag ship damaged in Sevastopol harbour, air and sea launched drones, 29 Oct 2022, returned to active-duty 15 Aug 2023
10	Olenagorsky Gornyak	LST (L)	Ropucha-class landing ship. Severely damaged by sea drones off Novorossiysk, 04 Aug 2023
11	Ivan Golubets	Mine-sweeper	Damaged by sea and air launched drones, Sevastopol harbour, 29 Oct 2022
12	5 Raptor-class	Patrol boats	3 sunk, 1 damaged, Mar and May 2022 (four by Bayraktar TB2 drones), one by anti-tank missile, off Snake Island
13	BK-16	High speed patrol boat	Sunk by Bayraktar TB2 drone, off Snake Island, May 2022
14	Serna-class	Landing craft	Sunk by Bayraktar TB2 drone, off Snake Island, 07 May 2022

Table 3 - List of Russian Warships Sunk/Damaged by Drones

The fact that Russia's control of the Black Sea has diminished is evident from several factors. First is the almost complete withdrawal of Russian Navy units almost completely from Crimea, especially from their major naval base at Sevastopol, with most of the Black Sea Fleet major units now being based at the Russian port of Novorossiysk. Secondly, the damage to major naval units and the threats of attack by drones and missiles have severely dented the Fleet's offensive capability to attack targets ashore, evidenced by the apparent cessation of sea-based attacks on Ukraine. Thirdly fact is the greatly diminished capacity of the Black Sea Fleet to provide logistics support and amphibious landing capability to land forces, especially in Crimea, which now relies on rail and road transportation, or on civilian ferries, both of which are also under regular attack.

Finally, the Ukrainian Navy's counteroffensive has severely restricted the Russian Navy's capability to enforce the exclusion zone in the western part of the Black Sea. This is evident from the fact that the number of merchant ships damaged, sunk or interdicted by Russian forces in the Black Sea has diminished from a peak of 18 ships in 2022, to five in 2023 and none in 2024. The eastward retreat of the Black Sea Fleet and the rerouting of merchant traffic bound for Ukraine along the coasts of Bulgaria and Romania have ensured that merchant traffic to Ukraine has also resumed, though it remains much lower than peacetime levels.

Drones: Game-changers in the Maritime Battlespace?

The fact that Ukraine has managed to fend off one of the most powerful navies in the world without possessing a navy worth the name has prompted many analysts to term sea drones as game changers in maritime warfare. While it is tempting to generalise, he lessons emerging from the Ukraine War regarding the use of sea drones, there is a need for restraint due to several factors. Firstly, the war is not yet over, and things could change dramatically in the maritime battlespace, as indeed they have over the past two years. Moreover, the geographical context of the Ukraine War is unique from the maritime point of view, being fought in a landlocked sea, as opposed to the open waters of the world's oceans. The Montreux Convention, which prevents warring parties in the Black Sea from reinforcing their naval forces, once the battle has been joined, makes it even more unique. However, despite these factors, it must be acknowledged that drones have undoubtedly changed the face of warfare, particularly on land, and to a lesser degree at sea. Consequently, the reasons for the success of sea drones, as well as their current limitations, are examined in subsequent paragraphs.

Sea drones owe their success to their versatility, low cost, and expendability. They come in several sizes and capabilities, ranging from small, short-range surveillance drones, used to patrol harbours to the Magura V5 sea drones, which have a warhead of 300 kg (equivalent to a heavy-weight torpedo); and the even larger Sea Baby drones used to attack both ships and infrastructure with a warhead of 800 kg (twice the payload of a Tomahawk missile). Both the Magura V5 and Sea Baby have been used to attack Russian ships and infrastructure over 800 km from Ukrainian ports.

Sea drones are easy to deploy; they do not require infrastructure such as jetties or harbours, any waterfront with a reasonable gradient will suffice to store and launch them. Drones also benefit from the fact that the vast majority are commercially manufactured and can be easily assembled on the front line. Most importantly, drones are much cheaper than their targets, the Magura V5 drone costs USD 40,000 as opposed to warships and submarines costing hundreds of millions of dollars. Finally, unlike manned machines, drones are unmanned and hence, tireless and expendable, and most importantly, they save precious lives; Ukraine is estimated to have manufactured 200 drones, of which 24 have been expended or destroyed, without the loss of a single life.

Drones also have several limitations. Their range, sensor and explosive carrying capacity, as well as their sea-keeping ability, vary directly with their size. Any increase in these capabilities requires increasing their tonnage, with concurrent adverse effects on their speed and stealth characteristics. Of course, underwater sea drones could ensure much better stealth, but they are limited by speed and their operating mechanism, and their command-and-control mechanism is also much more complicated. Guiding a drone to its target also requires accurate intelligence and up-to-date maritime domain awareness, which requires constant satellite surveillance coverage of the maritime battlespace. In the case of Ukraine, GPS and Starlink satellites are being used by operators ashore to guide the drones to their targets, intelligence on which is also being substantially supported by Western surveillance assets. However, such facilities are unlikely to be available over the open oceans to all except the most advanced militaries. Moreover, sea drones need to be tethered to an operator through a satellite communication system of adequate bandwidth, which can be jammed by the adversary. These constraints will limit the effectiveness of attacks against warships by sea drones on the high seas. The effectiveness of sea drones against well-defended harbours is also limited because traditional harbour defences, such as floating barriers and shore-based weapons can effectively thwart most such attacks, as has been seen after the deployment of barriers and other defensive measures off Sevastopol and the Kerch Bridge.

The above limitations are illustrated by the fact that all the ships attacked by sea drones (except for one missile corvette) were lightly armed and had limited sensors for the detection of small targets. All of them (again, except for the corvette) did not have high-speed capability, preventing them from outrunning the Magura V5 drones, which operate at peak speeds of over 40 knots. The tonnage of vessels sunk by conventional weapons, over 25,000 tons (Table 2), is also almost three times that sunk by sea and air drones, at 8,750 tons (Table 3), and comprises larger and better-armed ships.

Conclusion

The Ukraine War has demonstrated the immense potential that drones have in maritime warfare. While the extensive use of unmanned vehicles by the Ukrainian Navy was born out of necessity, it helped that Ukraine was already proficient in both shipbuilding and drone technologies. Their success in sinking 11 warships (including three medium-sized warships) and seriously damaging six more has been due to a combination of various factors. These have included: outstanding technical know-how and innovation in quickly assembling and constantly improving the sea drones; excellent intelligence on the positions of Russian ships; unstinting satellite surveillance and communication support from the US; and the confined sea room available to the Russian Navy, combined with poor tactics by the Black Sea Fleet.

The analysis in this article has also highlighted that despite these factors in their favour, drones have not been as effective as conventional naval weapons, such as missiles, torpedoes and guns. However, technical advancements and the use of Artificial Intelligence (AI) are already reducing of the many limitations that drones have, and as time goes on, swarms of drones armed with AI could overwhelm better-armed and larger war vessels. In summary, while sea drones are not some 'Silver Bullet' that can replace the existing arsenal of naval weapons, or indeed make warships obsolete, they represent a new and potent option for navies, which in the coming years will attain greater potency, perhaps even becoming the weapon of choice in maritime warfare.