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Ukrainian USV (Uncrewed Surface Vessel) attack on ships of the Black Sea Fleet Lessons learned

Paul Burlacu[1], Sandu-Valentin Mateiu[2]

[1] "Mircea cel Batran" Naval Academy
[2] Captain (N) Retired
paul.burlacu@anmb.ro, sanduvalentinmateiustefan@gmail.com

Abstract : The USVs attack on the Russian Black Sea Fleet naval base in Sevastopol opened a new chapter in warfare at sea through the appearance of a new weapon and the consequences of this attack on the conduct of the war in Ukraine. A primary analysis of the attack and the weapon, as well as its consequences at the tactical, operative and strategic level provides us with the first lessons regarding the new way of fighting at sea.

1. Introduction

The war in Ukraine represents a crucial event with major and long-term effects on global, regional and our country's security. Among the many novelties brought by this war, the attack carried out with USVs (Uncrewed Surface Vessel / maritime drones) on the BSF ships offers some lessons, both at the tactical and operational-strategic level.

Fig. 1. USV (twitter/ H I Sutton @CovertShores).

The appearance for the first time in battle of such weapons that sum up, at an acceptable cost, technological novelties, as well as the way they were used in battle has immediate tactical implications, requiring rapid adaptation to these changes, both technological, tactical and doctrinal, as well as operational and strategic, including future naval strategy and fleet design.

The USVs used as autonomous attack weapons bring, like their aerial equivalents, the suicidal aerial UAVs (loitering munition), important novelties compared to the known USVs used as autonomous platforms, as well as the AUV (autonomous underwater vehicle) , although there will probably be some convergence (with the former becoming the weapons of these platforms).

Historically, the use of such surface weapons has a precedent, such as the incendiary ships during the British attack on the Armada or the homing vessels of the Second World War, but now technology has allowed, and the ingenuity generated by the realities of a harsh war, implemented such a weapon. The technological elements were already present, but the idea of combining them into an effective weapon, as well as devising the tactics of using them in battle, opened a new chapter in the battle at sea. In the air, the suicide aerial UAVs have as their predecessors the anti-ship missiles (different, but with some similar technical-tactical characteristics) and, on the surface, the USVs have as their predecessors the torpedoes (with the difference that the USVs do not need the launching platform, as in the case of torpedoes).

In fact, the technological revolution is much broader, ushering in a new era, that of robot weapons which combines advances in materials, propulsion, communications, automation and AI. In the end, we will have robot platforms with robot weapons, but it is premature to think that classic manned platforms are a thing of the past (not the case of a...Jeune Ecole). The fleet remains, before the ships and their weapons, the people, with the triad that gives them value: patriotism, integrity and competence. This is what made the difference in the case of the attack with USVs, the immediate impact being the result of the human response: the defense tactics of the BSF ships, the tactical reaction after the first attack, but also the reaction at the operational-strategic level.

2. The technology

The USV system exploited technological elements available, in part, only to the West and its allies, the rest being available on the market. Thus, the platform and propulsion were COTS, but the essential systems for ensuring autonomy (semi-autonomy), sensors and communications belong to the first category.

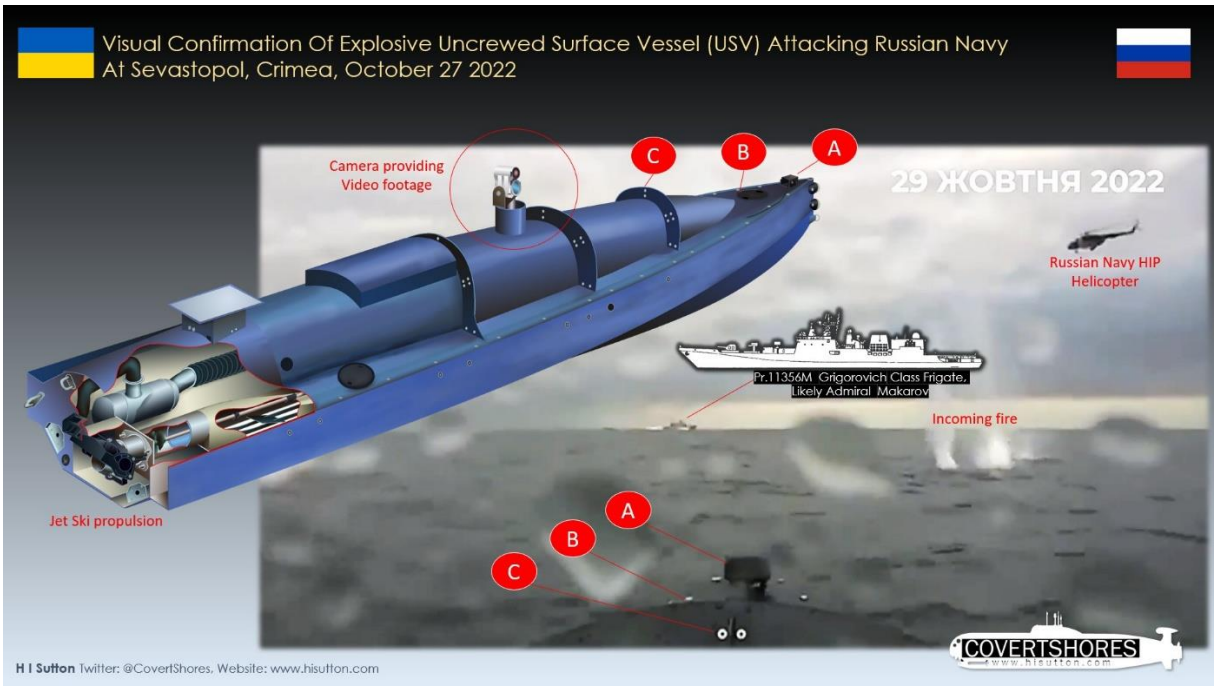


Fig. 2 USV (twitter/ H I Sutton @CovertShores)

Technological evolution is the main variable in the evolution of war at sea, requiring technical, tactical and operative-strategic adaptations in order to find an answer to new technological challenges. The technological leap in various fields in the last period, as well as the implementation of these technologies in the products on the market, have provided most of the elements necessary to build the new USV weapon. The key element, however, is technologies such as STARLINK, inaccessible to Western adversaries.
Some are already mature and relatively readily available technologies, such as low-cost and reliable high-performance hulls and jet propulsion systems with speed regimes that allow for adequate economic speed for a greater range and high-speed target engagement. Notably, the large warhead of USVs make them much more powerful weapons than known UAVs.

However, optoelectronic/infrared/laser sensors belong to sensitive, dual-use, military-civilian or military-only technology. Moreover, the communications system using Starlink satellites, as well as the military GPS system, are accessible only to Western allies. These systems can be jammed, but with great difficulty (Russia tried in both cases, succeeding, partially, in certain areas, with the GPS system, but not with low interception Starlink).

The USVs used in these attacks assumed the existence of: 1) a platform with very good nautical qualities; 2) a reliable and versatile propulsion system; 3) a system of sensors to provide a complete, multispectral image of the environment (mostly in passive mode); 4) a high-performance satellite communications system; 5) a guidance system (auto-pilot, GPS & inertial); 6) a command and control system, which implements the commands received by radio (in the future, AI will play an increasingly important role in this system, which will allow an increasingly greater autonomy, up to the level of completely autonomous system, but here comes the issue of the necessary human validation). The technological evolution of these systems will lead to a degree of autonomy characteristic of the "war of the robots", systems acting autonomously and in network, with the human element having a minimal but crucial role, that of mission planning and validation of decisive actions.

The advantages of the USVs used in this action are unique, primarily related to the elimination of the human element from the actual attack equation: 1) the autonomous system eliminates all problems related to preserving the life of the human crew, the USV being suicidal by definition; 2) the performance of the attack is exceptional, being a combination of commands given by a pilot who is not in danger of being killed and fully automated systems; 3) the system is relatively cheap (especially compared to the platform it attacks, but also to other weapon systems, such as torpedoes or anti-ship missiles); 4) however, at the same time, these USVs are easier to intercept, but only if they are detected in time to allow a rapid and eficient reaction (the stealth element being of crucial importance in order to avoid their detection).

Technological evolution will lead to a convergence of weapon systems, which, without eliminating important aspects such as those related to the environment (submarine/surface/air) and cost (technical-tactical performances of weapon systems are, generally, directly proportional to their price) will change the perception we have now, oriented towards traditional systems (mines, torpedoes, anti-ship missiles, aerial drones, surface drones, submarine drones), as well as (with the increase in the range of these weapons), the relationship between the carrier platform and these weapons. Questions will arise regarding the relationship between manned and unmanned platforms and the vulnerability of manned platforms to these new weapon systems.

In the short term, problems arise, first of all, of defending the traditional platforms against these new weapons. The technological elements have already appeared, such as laser systems, programmable artillery projectiles or others (for example, cluster bombs can be used against UAV swarms), but the cheaper the weapon system is (having, however, a significant effect on the target), more question of efficency arises: 1) how much is the defense system cost relative to the cost of the weapon (an anti-aircraft missile against a cheap UAV? thus the need for cheap defense systems such as small caliber AD artillery); 2) the high cost of the platform relative to the cost of these new weapons.

The topic is large, relating to the transition from traditional to robotic platforms in a long and complicated (but balanced) transition process. We will focus only on the issue of surface USVs used in this attack.

3. Tactical level

USVs bring new elements to the fight against surface targets, just as UAVs bring to the air. The element of novelty is given by the technical-tactical characteristics (speed and maneuverability, stealth), but, above all, by the autonomous element (suicide), similar to UAVs (loitering ammunition) in the air. Especially ships in low speed regimes or stationary ones at anchor in port or outport are vulnerable targets to such attacks.

Though, we don't have a complete novelty. Close-in defense of the ship against surface threats was relatively recently confrunted with attacks of such small surface ships (led by a suicide pilot, as the terrorist attack against the USS Cole), and the issue of defense against such weapons has been debated and solved by installing large-caliber machine guns.

Of course, the simple solution is to have a human spotter and engage the target with small-caliber fire, but the classic spotter problem arises (the ability to maintain increased vigilance over a long period of time). However, we have the solution of passive multispectral (optoelectronics/infrared) & active (radar) senzors and CIW (close in weapons) systems like the Phalanx, the combination of small guns and radar which can solve the problem, beyond their original purpose (anti-missile systems).

The problem of defending the platform against the USV is the classic one - a fast sensor-killer chain with a fast and precise reaction: target detection, localization, classification, tracking, selection of a weapon system and neutralization of the target. However, specific elements appear, such as: the need for permanent surveillance of the near perimeter of the ship, given that these autonomous systems are not launched from a platform (which would be much easier to detect); the need for an "all azimuth" (360 degrees) optoelectronic/infrared surveillance system (and a laser warning system, in the situation where the USV uses such a means, although, very likely, the USV will seek to leave a footprint as small as possible) and a high-performance radar system (ability to detect small surface targets with a low reflective surface (RCS), at different speed regimes: approach at very low speeds (minimum speed for Doppler), and then attack with high speeds, in the final phase, near the target (minimum radar range).

Fig. 3 One Admiral Grigorevici fregate demaged after the attack (pravda.com.ua)

Apparently, the problem is simple, but in the case of the first attack, at least one Admiral Grigorevici-class frigate was damaged, although in theory it had high-performance radar systems as well as multiple defense layers (A 190, AK 630 artillery).

Fig. 4 Admiral Grigorevici fregate class (Naval Technology)

The problem is all the greater since we cannot speak of a strategic surprise (previously, a similar USV went aground in Crimea), but only of a tactical one (especially, the target, the place and the time chosen).

Fig. 5 USV went aground in Crimea before the attack (twitter/ H I Sutton @CovertShores)

Notably, the attack was a combined one, with the UAVs providing the necessary diversion to distract the defenders from the USV attack. The attack was repulsed with combined fire from the ship and an helicopter. The

following attacks were repelled by the measures taken to protect the entrance to the port and avoiding anchorage in the outport (previously, deficient, from the lack (superficial use) of usual protection elements – minefields, anti-torpedo nets to the mistake of anchoring ships in the outport without proper defence).

Fig. 6 Sevastopol naval base increased harbor defenses and last USV attack (twitter/ H I Sutton @CovertShores)

In conclusion, the attack with USVs is only one more element that complicates the close defense of the ship against surface attacks, but also the defense of the naval base against such attacks. This kind of USV attack, like UAV attack, adds to the known surface, air (anti-ship missiles, aviation) and submarine threats (autonomous underwater vehicles added to the classic submarine threat). New tehniques, tactics and procedures has to be elaborated in order to have a viabile answer to these new threats. A future naval doctrine has to take account of these new realities.

4. Operational-strategic level

The Russian reaction after the USV attacks shows the big impact the attack had at the operational and strategic level: the BSF withdrew part of its ships from Sevastopol to Novorossisk and its offensive actions were diminished. Basically, after the attack, BSF warships were used as arsenal ships launching Kalibr missiles from areas located mainly in the southern vicinity of the Sevastopol naval base.

The BSF situation was already a complicated one even before this USV attack. At the beginning of the war, the BSF easily imposed *sea control*, in the conditions where there was practically no Ukrainian fleet. The result was that Russia easly imposed a naval blockade and threatened an amphibious landing at Odessa (which did not occur due to the failure of the Russian land offensive).

However, the superiority of the BSF did not lead to the expected result, given the fact that, in the configuration of the North-West Black Sea theater of operations, the interaction with land is decisive.

Fig. 7 Black Sea (www.sciencephoto.com)

Thus, modern sensors (long-range radars) and shore-based weapon systems (anti-ship missiles batteries) as well as land-based aviation (to which UAV/USVs are now added) have the ability to intervene significantly in the battle at sea. One consequence is that naval bases are no longer secure, ships being safe in them only to the extent that the bases are well defended against air and sea attack.

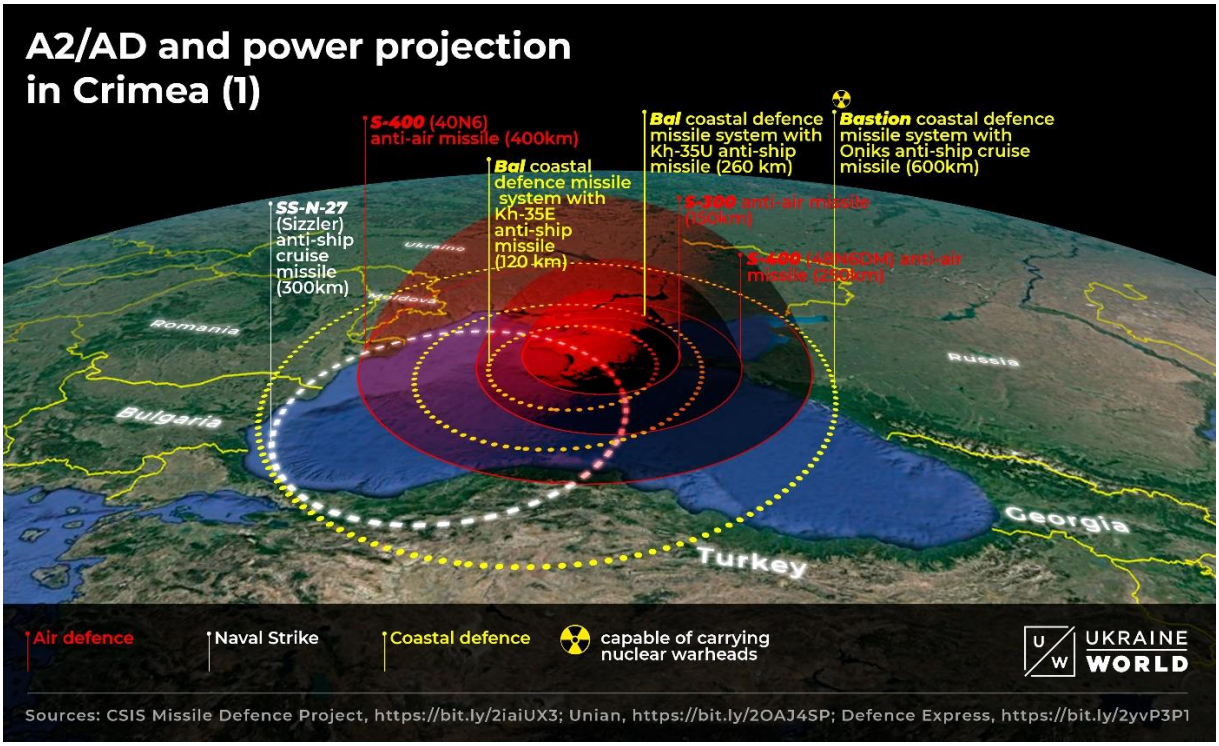


Fig. 8 Russian A2AD in Crimeea (ukraineworld.org)

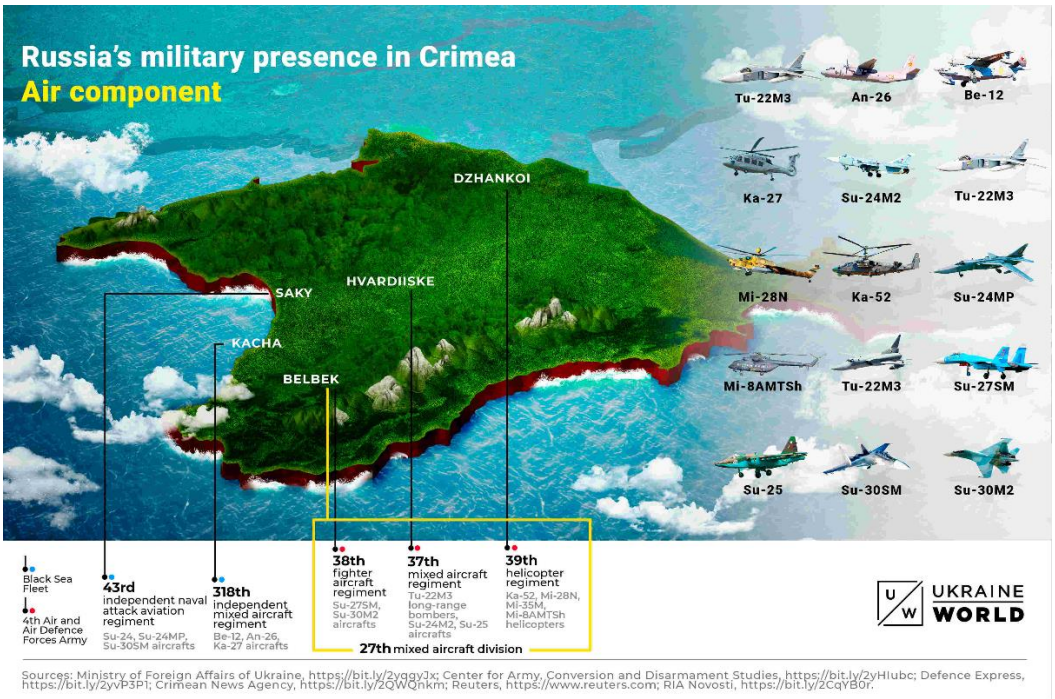


Fig. 9 Russian Air Forces based in Crimeea (Atlantic Council)

Russia had a clear picture of this situation, evidence being the A2AD system in Crimea, as well as the BSF naval aviation based there, but BSF leadership ignored the informational superiority of Ukraine (a C4ISR system, in which the West probably has an important role) and the existence of Neptun/Harpoon anti-ship missile batteries, as well as the emergence of UAVs and USVs in naval combat (interestingly, Russians quickly learned and attacked with USVs: a Russian USV attacking a Ukrainian strategic bridge).

Fig 10 Ukrainean Su-27 over Snake Island (Ukraine Weapons Tracker)

As Russia failed to impose air superiority over Ukraine (more precisely, the Odessa - Kherson area) and the Black Sea (the Snake Island episode is relevant), the Ukrainians had the freedom of movement that allowed them

to attack BSF ships, the biggest success being the sinking of the cruiser Moskva (although it had a complex and layered anti-aircraft/missile defense).

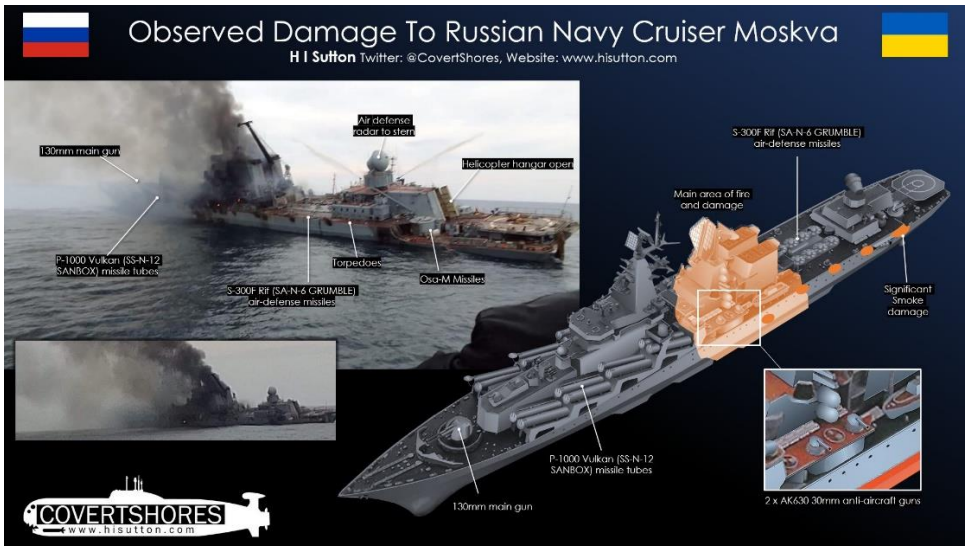


Fig. 11 The end of BSF cruiser MOSKVA (twitter/ H I Sutton @CovertShores).

The USV attack in Sevastopol revealed precisely the vulnerability of naval bases. Vulnerable in its main base, the BSF has only a reduced ability to maintain *sea control*, managing, however, to impose a limited naval blockade. We have a situation where both sides manage the denial of the sea to the other side (*sea denial*), but cannot impose *sea control.*

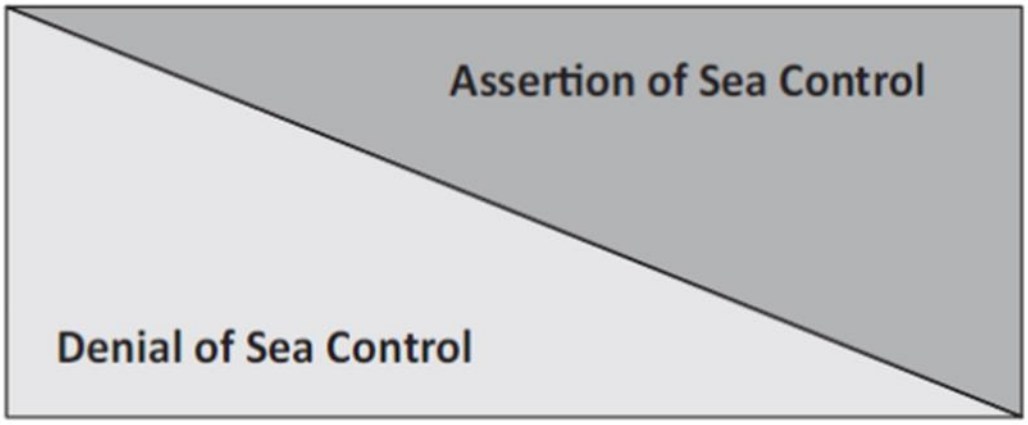


Fig. 12 Sea control and sea denial (Admiral Stansfield Turner, „Missions of the US Navy")

An important role in reaching this situation was played by the USV attack on the Sevastopol base. Strategically, the situation in which the BSF finds itself no longer allows it to participate in the war in Ukraine in support of the Russian ground forces but to a small extent (by launching cruise missile against ground targhets).

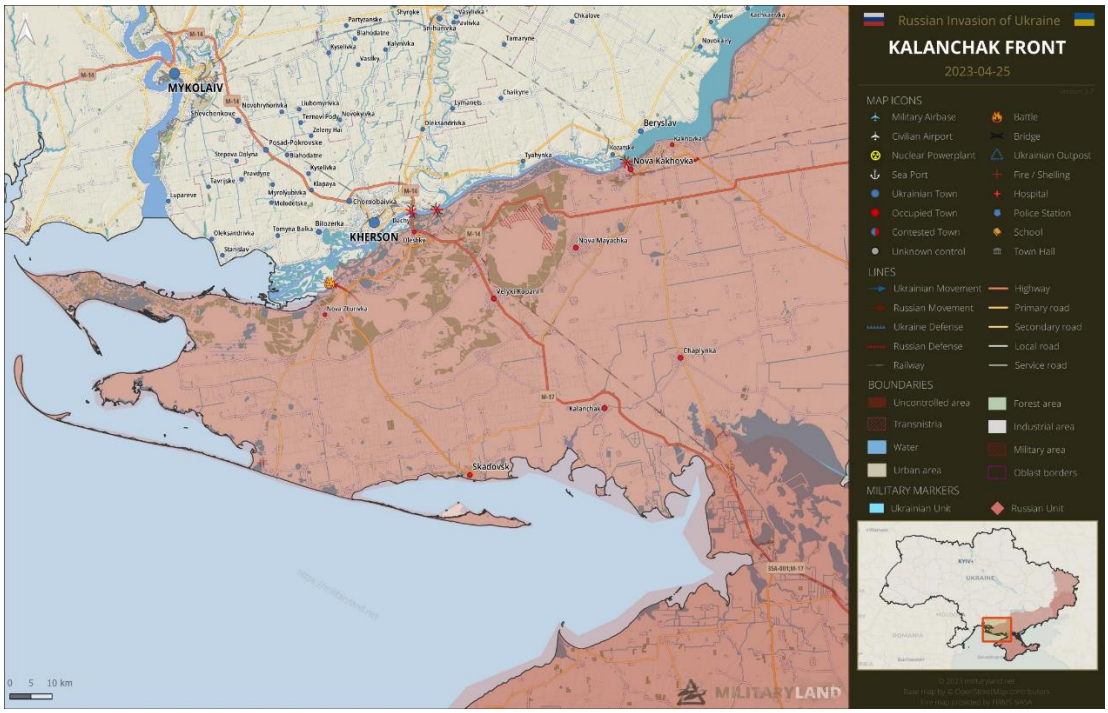
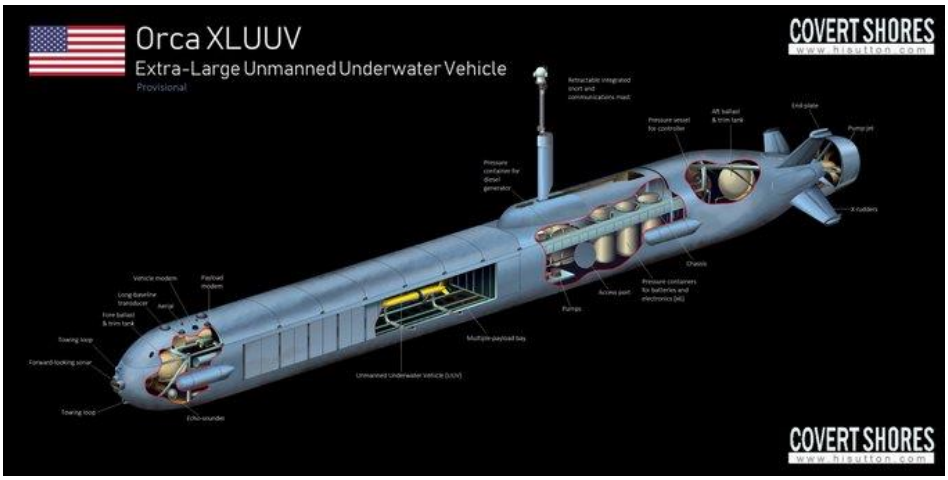


Fig. 13 Khalanchak front (militaryland.net)

Conclusions

It is too early to draw all the conclusions regarding the USV attack on the Sevastopol base, but some conclusions can be drawn: 1) warfare at sea will be transformed by the advent of autonomous weapons, such as UAVs and USVs, a whole range of robot weapons will appear, changing „the face of batlle" - the whole range of weapon systems we know today; 2) naval platforms must be defended against these new weapon systems, thus the fight against surface targets will take new forms; 3) naval bases are vulnerable to attacks by UAVs, respectively USVs; 4) the design of the fleet must take into account these developments, both for the design of the defense systems of ships against these new weapons systems and also in the development of such new weapons systems as part of the ships or land based. The issue of the ratio of manned naval platforms to that of autonomous platforms in the fleet design also needs to be considered. During peacetime, the problem of hybrid war at sea must be analyzed, USVs being, alongside the classic one of mines, the ideal weapons for the unassumed attack of critical infrastructure at sea.



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