

The Aerial War Against Ukraine The First Six Months

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This memo analyses the first six months of Russia’s aerial war against Ukraine. Emphasis is shed on Russia’s Operational Tactical Aviation (VVS), heavily utilised in Russia’s military intervention in Syria in 2015, where Russia regained its confidence after its performance in the Russo-Georgian war, in 2008. But the aerial domain in Ukraine contains a completely different set of operational factors that have challenged the VVS, despite pre-war assumptions from the Western military analytical community that it would quickly subdue elements of Ukrainian ground and air force assets.

MINUTES AFTER PRESIDENT Vladimir Putin announced the launch of a “special military operation” on 24 February 2022, Russia’s Operational Tactical Aviation (VVS), part of the Aerospace Forces (VKS), struck Ukrainian airfields, satellite communication facilities, ammunition depots, and control towers. Strikes against fixed targets lasted 48 hours and aimed to establish an unchallenged aerial environment for Russia’s renewed invasion, this time with the stated goals to “demilitarise” and “denazify” all of Ukraine.¹ Prior to 24 February, as part of a very drawn-out military build-up in areas adjacent to Ukraine’s border, a variety of more than 300 aircraft were stationed in Russia’s western and southern military districts. Satellite imagery displayed, too, a range of staging grounds at the Luninets air base, in Belarus.² Western military analysts assessed that the VVS held the technical capability to deploy combat operations, in large and mixed formations, to subdue Ukrainian aerial assets, ground-based air defence (GBAD), and surface-to-air missile (SAM) systems. But these systems survived the initial wave. Follow-up strikes were not conducted and the failure to carry out a widely anticipated air and missile campaign, in support of a large-scale mechanised drive on Kyiv and other urban settlements puzzled the analytical community. The Ukrainian air force had dispersed its aircraft prior to the invasion and thus remained capable of carrying out defensive, and at times offensive, counter-air and ground-attack sorties, all the while damaging international perceptions of Russia’s air force.

Ukraine has managed to sustain and disperse its GBAD and SAM systems, at the same time as it even displayed the logistical capacity to replenish them with Western material support.

Russia’s intervention in Syria in 2015 saw Moscow lean heavily on the VVS. That intervention sought to safeguard the al-Assad regime from a range of non-state actors who challenged his rule, practically enabling the VVS to become the al-Assad regime’s own air force, which eventually tilted the politico-military balance in Damascus’s favour. The VVS conducted intense flight sorties in Syrian airspace, with hardly any notable challenges, much thanks to the fact that the opponents lacked noticeable GBAD and SAM systems and had relatively few man-portable air-defence systems (MANPADS). But Russia’s aerial war against Ukraine encompasses a completely different set of operational-tactical challenges. Geography is also an undeniably important consideration: Ukraine covers 604,000 km² and from east to west stretches over 1250 km; and 550 km, from north to south. Prior to the full-scale invasion, the VVS had never faced an operational environment such as the one it now faces in Ukraine. Perhaps the aerial war and the challenges it has produced for the VVS in Ukraine are the real reasons for scaling down the significance of the previously much-vaunted airshows in Moscow and other cities? Allegedly due to poor weather conditions, authorities cancelled the aerial part of the 2022 Victory Day (9 May) parade that commemorates the Soviet Union’s victory over Nazi Germany.³

RESEARCH QUESTIONS AND OBJECTIVES

Attention to the aerial domain of the ongoing war has begun to increase as Western military analysts have questioned the performance of Russia's air force. Western analysts, including this author, initially pondered whether Moscow deliberately held back its aerial capabilities in Ukraine. Or had previous assessments overlooked the human element, while relying too much on the technical capabilities of the VVS and underestimating Ukraine's air defence environment, the training, and modernisation its armed forces and air force had undergone as of 2015? Therefore, this memo addresses the following research question: What were the operational factors challenging the VVS in Ukraine in the first six months of 2022? The presence of the VVS has primarily involved fixed-wing fighter, fighter-bomber, and attack aircraft. The operational-tactical Naval Aviation has also been utilised.

DELIMITATIONS AND SOURCES

An assessment of other types of aircraft, such as Army Aviation or Transport Aviation, is not conducted here. A search for analogous operations, occurring prior to 24 February 2022, and comparable to those of the VVS in terms of complexity and intensity of combat air patrols (CAP) and the remote nature of the area of engagement has been inconclusive. The qualitative analysis conducted here consists of two parts: the first part provides a brief background assessment of the VVS in Georgia in 2008 and in Syria in 2015. This assessment lays the foundation for the second part of the analysis: namely to discuss and assess the primary focus, the operational factors that challenged the VVS during the first six-months of the war against Ukraine. The sources relied on concern Russia's military intervention in Syria, in 2015, while some aspects of the VVS's role in the Russo-Georgian war, in 2008, are also briefly considered.

Russian primary sources are also utilised: these include official documents, interviews, and other relevant open source material, including Telegram channels concerning the deployment of the VVS in Syria and Ukraine. Some were recorded at the time of the event, some in retrospect. Secondary sources consist of articles and reports, such as those produced by the Royal United Services Institute (RUSI), as well as news articles in English and Russian. More importantly, both primary and secondary sources emanating from Russia and Ukraine may be biased and methodologically questionable. Both parties remain eager to present their point of view. Data and assessments concerning the war also may be over-inflated or simply coloured by propaganda. Some may

even contain personal remarks, and can therefore be considered as merely anecdotal. Methodological inconsistencies may especially be present in information obtained via the Russian military blogger community. The Kremlin has permitted a growing informal military blogger community, while increasing domestic censorship. This community is not entirely dependent on information released by the Russian Ministry of Defence (MoD) and has at times even challenged official statements concerning the full-scale war against Ukraine.⁴ Some bloggers have reported from the front line, while some are even attached to Russian Ground Forces in Ukraine. President Putin has even promoted some "bloggers" to official positions, possibly in an attempt to secure the loyalty of this community.⁵ Members of this community consist of military correspondents; some others have links to the MoD and other quasi-military organisations, such as the Wagner Group. Rybar is one of the most known Telegram channels within this community.

As regards visual evidence concerning downed Russian aircraft in Ukraine, this memo has employed Oryx International, an open-source intelligence website that documents military equipment losses for Russia and Ukraine as of February 24, 2022. Measuring the validity and authenticity of the visual evidence involving a damaged or non-operational Russian battle tank remains far more difficult when comparing it to a downed Russian aircraft. Russian tanks have several times throughout the conflict been captured by the armed forces of Ukraine and then re-utilised in combat, making it more difficult to assign "real" ownership. But as regards the validity of a downed VVS fighter, a Russian aircraft can simply not be re-used and the separation is easier given also the clear set of insignias, and a separate set of technical equipment in these fighter jets also strengthens the authenticity and validity of the visual evidence presented by Oryx International.

THE VVS

The role of the VVS remains centred on providing Ground Forces with aviation and combat support, principally viewed as "flying artillery,"⁶ which can strike enemy infrastructure, troops, and aviation; and on defending critical objects and groupings of forces in Russia from aerial threats. The VVS is composed of fighter, interceptor, fighter-bomber, and ground attack aircraft. Driven by the objective to unite under a single command the forces and means responsible for ensuring Russia's security in the airspace, the VVS took on a combat role in the creation of the VKS. The role of a fighter aircraft is to primarily achieve air superiority

and neutralise enemy fighter aircraft or, in the interceptor role, to target enemy bombers. Attack aircraft are on the other hand equipped to strike ground or naval targets, provide close-air support to friendly troops via the destruction of heavily armoured or dug-in enemy forces, and discover and destroy air defences and neutralise radars.⁷ While Russia has closely analysed the application of Western air power, drawing lessons from various interventions in the Middle East, its own doctrinal approach to air power remains Army-centric, preventing it from pursuing its own aerial doctrine and independent concept of operations. Arguably, the Russian application of air power has remained limited, as recent Russian military operations have until 24 February emphasised smaller-scale operations.⁸ The five-day war with Georgia in August 2008 particularly revealed poor interplay between the various branches of the Armed Forces, as well as deficiencies in planning air and ground operations in concert. One concerns deficiencies in providing accurate real-time targeting data to the VVS: it took several days to engage Georgian air defences. Russia lost six aircraft, and up to four more due to friendly fire. Among other things, the war highlighted difficulties in conducting night-time CAP. The war's aftermath led to critical assessments within Russia concerning its military performance, culminating in the "New Look" reform that sought to fundamentally reform the Soviet mass-mobilisation army and transform and adapt it for conflicts in the post-Soviet space.⁹ Enhancing the aerial domain became a high priority, resulting with the acquisition of 377 combat aircraft of various types during 2009–2021:

- 134 Su-34 fighter-bombers;
- 140 Su-30M2 and Su-30SM multi-role fighters;
- 103 Su-35S multi-role fighters.¹⁰

The reform sought to gain a limited parity and match the intensity and efficiency of air power demonstrated by the United States and NATO allies, especially the aim of increasing the deployment of precision-guided munitions (PGMs).¹¹ The theoretical drive underpinning the reform envisaged preparations ahead of a possible conventional clash with superior U.S. and NATO air forces. In reality and prior to February 24, Russia received experience in aerial environments against non-regular forces that neither held formal air forces nor advanced GBAD/SAM capabilities.

The Russian MoD received approximately 29 newly built tactical fixed-wing combat aircraft in 2022:¹²

- 6 Su-57 fifth-generation stealth-capable multi-role fighters;
- 7 Su-35S multi-role fighters;
- 10 Su-34M fighter-bomber/strike aircraft;
- 4 Su-30SM2 (Naval Aviation);
- 2 JAK-130 light attack/training aircraft.

THE SYRIAN INTERVENTION IN 2015

Since 2011, the Kremlin had been shoring up the al-Assad regime with limited diplomatic, military, and financial means, but stepped in militarily during September 2015 to reverse the gains made by the anti al-Assad opposition, also enabling the Syrian Army to shift from a defensive to an offensive posture.¹³ This was the newly reformed VVS's first combat experience outside the post-Soviet space following the five-day war against Georgia in 2008. The VVS entered Syria with new weaponry, but lacking the combat experience and understanding of the capabilities that the reform had generated. Prior to intervening, the Kremlin factored in the US presence in Syria, in the form of *Operation Inherent Resolve*, the US-led international coalition against the so-called Islamic State (IS) that had been underway for more than 12 months. Syrian airspace was significantly congested with operations by US, Turkish, and Israeli aircraft, raising the risk of a direct confrontation. The US coalition was nevertheless operating in eastern Syria, targeting primarily IS strongholds. At the same time, Russia mainly targeted the anti-Assad opposition in western Syria. This enabled the Kremlin to gain a situational overview without risking a direct clash with the international coalition consisting of approximately 60 countries.¹⁴

The existence of a de-conflicting channel, whereby Russian and US military officials shared their coordinates to avoid aerial collisions or confrontations, made it safer for the VVS to run intense CAP.¹⁵ The initial composition of the VVS in Syria comprised 32 combat aircraft: twelve modernized Su-24M front-line bombers, 4 Su-34, 4 Su-30SM multi-role fighters, and 12 Su-25SM attack-aircraft and was largely based at the Basel al-Assad airbase (referred to hereafter as the Khemimm airbase), located approximately 55 km from Tartous, in Latakia province, approximately 24 km from the front line.¹⁶ Securing overflight rights through Iraqi and Iranian airspace was crucial, as it enabled Russia to move aerial assets from southern Russia more quickly.¹⁷ The VVS grouping was able to fly a short distance to engage targets based in the immediate surroundings of Damascus and in the northern city of Aleppo, a 15-minute

Table 1. The number of combat sorties by the VVS and Fleet Aviation in Syria in 2015 to 2018

Date	Combat sorties	Average no. of flights
December 24, 2015 – February 22, 2016	6,500	107
September 2015 – March 2018	36,000	42

Source: Pukhov, Bondarev (eds.) *Russian Air Operation in Syria – Menacing Sky-Aviation in Modern Conflict*. Centre for Strategic Analysis and Technology, Moscow, 2018, pp.201–233.

flight from Latakia. At the same time, coalition war-planes deployed from the Combined Air and Space Operations Centre at the Al-Udeid Air Base, in Qatar.

The vvs managed to double the rate of air strikes compared to those launched by the international coalition, in some instances launching 60 CAPs every day. At the same time, the US and its allies launched seven sorties on average since launching its mission in September 2014. But while coalition war-planes almost exclusively utilised laser- or GPS-guided precision munitions, the vvs leaned heavily on “carpeting” opposition strongholds with unguided cluster bombs, thereby indiscriminately targeting in a single pass.¹⁸ Russian Ground Forces leaned primarily on an “advise-assist-accompany” model, bringing in forces from the Russian Special Operations Forces Command, augmenting Syrian Arab Forces, and Iranian, and Hezbollah fighters in reconnaissance and air strike missions.¹⁹ Russian Forward Air Controllers (FACs) were notably embedded with these ground elements, identifying and transmitting coordinates of targets. Due to deficiencies in intelligence, surveillance, and reconnaissance (ISR) capabilities, the vvs targeted static targets pre-identified by embedded ground units. By mid-2017, up to ten Russian fast jets would deploy four times a day, waiting for targets indicated via embedded FAC units.

The fixed wings in Syria

At the initial stage of the intervention in Syria, and mainly due to the lack of aerial threats, the vvs employed the Su-25SM and then rotated it with the Su-30 multi-role fighter, in the non-traditional role of light bombers, flying at an altitude of more than 4 km. Until spring 2017, the main vvs workhorse was the Su-24M, comprising 50 percent of all combat sorties; their typical armament was four 250 and 500 kilogram “dumb free-falling” bombs, including cluster munitions and concrete-piercing munitions, intended for underground bunkers. Between 30 September and 30 October 2015, the vvs carried out 1391 combat missions on approximately 1623 targets.²⁰ A new intensified phase commenced when IS downed the Russian Metrojet flight 9268, carrying tourists from a resort in Egypt

to St. Petersburg, in October 2015. The number and intensity of tactical-aviation sorties, utilising Su-25SMs with unguided munitions, thus increased up to three times. On November 17, Russian tactical aviation performed 100 sorties daily for four days. Strategic aviation, notably twelve long-range aviation Tu-22M3 bombers operating from the Mozdok airbase, in North Ossetia, were also involved to increase the strike potential by a combat radius of over 2000 km. Strategic bombers, such as Tu-95MSs from Engels airbase and Tu-160s from Olenya Airbase were also deployed on November 17, flying over 6500 kilometres. The Tu-160 and Tu-95MS aircraft had never been used previously in actual combat. In this retaliation campaign, consisting of four days, Russia carried out 522 sorties on 826 targets, utilising both air-based cruise missiles, sea-based missiles and a variety of air bombs.²¹

At the height of the campaign, sorties exceeded 100 per day but did not exceed 70–80 missions per day: two to three flights per airplane, or three to four sorties for operable aircraft.²² Several factors explain the high intensity of operations: a) two crews per aircraft; b) a variety of technicians on the ground; and c) the constant ground presence of representatives from Russian aircraft, weapon, and equipment manufacturers. While vvs pilots undoubtedly added additional flight hours, questions still remain concerning the strain these missions had on aircraft and the toll and fatigue experienced by pilots. During November 2015 to May 2018, the vvs recorded just six aircraft losses, four due to accidents. A notable incident involved the downing of a Su-24M by the Turkish Air Force. Why so few losses? A significant number of flights were flown at higher altitudes and never below 4 km, thus making them safe from the threat of the few numbers of MANPADs possessed by either IS or the anti-Assad opposition. In 2018, the Russian MoD also claimed that 80 percent of its tactical aviation flight crews had served a combat tour in Syria.²³ A considerable number of strikes, approximately 97 percent, were conducted by employing inexpensive, “dumb,” unguided munitions.²⁴ These were mainly enhanced through the use of the SVP-24 Gefest Navigation/Attack system; its targets are programmed

into a 45-minute window that leverages Russia's Global Navigation Satellite System (or GLONASS, equivalent to GPS, or Global Positioning System, to automatically release unguided munitions at high altitude), well beyond the reach of MANPADS. By employing the SVP-24 Gefest, Russia believed it could equip older aircraft with unguided bombs with a similar accuracy to guided munitions.²⁵ Given the identifiable inaccuracies of this system, several "correction stations" were established across Syria to enhance the capabilities of GLONASS, which increased the accuracy from 30 percent to 40 percent. In a separate bid to increase accuracy, the VVS also resorted to striking targets with multiple bombs, relying as well on cluster bombs with incendiary munitions.²⁶ As a consequence of such high-altitude unguided bombing methods, leaning on the SVP-24 system would be of restricted applicability against an opponent with serious air defence and/or satellite spoofing capabilities.²⁷

While the majority of strikes in Syria appear to have been conducted with "dumb" munitions, Russia did employ guided munitions in combat for the first time.²⁸ The Syrian intervention generated intense debate within the Russian politico-military analytical community, especially concerning the principles of conducting "contactless" short military operations akin to the ones conducted by NATO in the 1990s and, later, in the "asymmetric" conflicts of the early 2000s. Russia's MoD acknowledges the importance of utilising the air force as a force capable of solving not only tactical, but also operational and strategic tasks. The MoD also admits, at length, that a military operation relying on the air force and naval fleet allows military operations to be carried out along a short course, with quick single strikes that minimise the possible risk of being drawn into long and costly hostilities.²⁹ The Syrian intervention, the MoD believes, was regarded as the first serious practical test of the reform of the Armed Forces and displays "how Russia mastered modern air warfare with a minimum of losses and saving human lives."³⁰ Russian analysts have also even argued, in a post-action report on the Syrian intervention, that airpower is far more crucial than forces on the ground.³¹ They added that the greatest threat to Russian aircraft was MANPADS, which forces aircraft to fly at higher altitudes and reduces their effectiveness.³² The VVS was deployed independently of ground operations³³ and Syria was also viewed as being a testing ground for refining the ability to integrate Russian Intelligence, Surveillance, and Reconnaissance (ISR) capabilities; Command and Control (C2); and precision standoff fires, a flaw that was highlighted in Georgia in 2008. In Syria, the VVS's

heavy deployment of fixed-wing assets used for CAP and strike missions allowed the air force to gain vital experience by testing modernised munitions in a relatively unchallenged aerial environment, where the length of the engagement was limited.³⁴

UKRAINE – FEBRUARY 24

The assessment of Western military analysts prior to 24 February 2022 was that Ukraine was qualitatively and quantitatively outmatched by Russia's conventional air power. Ukraine's Air Force was viewed as poorly equipped and underfunded, at the time consisting of approximately 110 fourth-generation aircraft: mainly the Su-27 and Mig-29.³⁵ The third generation consisted of Su-24 and -25 attack aircraft. Following the dismantling of the Soviet Union, Ukraine had no funds to sustain its former fleet of strategic bombers, and also scrapped a large fleet of fighter jets. Ukraine was assessed as not possessing a comparably strong capability (some analysts even referred to it as non-existent) to engage Russian air defence systems. As of 24 February 2022, the Ukrainian Air Force, albeit low on active pilots but with a large reserve of trained pilots, had approximately 50 MiG-29 fighters and 32 Su-27 fighters, and had as well trained to operate and service aircraft in temporary bases in the field.³⁶

During the initial phases of the full-scale invasion, Russian fixed-wing sorties conducted strikes against Ukrainian fighter aircraft and GBAD systems, disrupting the integration between the Ukrainian Air Force and its air defence infrastructure. All of this occurred while Russian cruise missiles engaged and destroyed several Ukrainian SAM sites in the southern and south-western parts of Ukraine.³⁷ Ukrainian Mig-29 and Su-27s were therefore forced to provide air defence in the first few days, until the Ukrainian GBAD systems had recovered, repositioned, and engaging Russian ground and aerial assets. The VVS was estimated to have deployed 350 fast jets,³⁸ although others assessed that Russia had deployed just over 75 aircraft.³⁹ The Ukrainian medium-range SAM Buk 9K37 system especially threatened Russian medium- and high-altitude air operations on the Kyiv and Kharkiv axes. Ukraine even claimed that it had downed approximately seven Russian aircraft on 24 February.⁴⁰

Ukraine generated between 20 and 40 missions in Ukrainian-controlled airspace each day. It is believed that at the onset Russia generated 200–300 sorties of unknown category each day, and then eventually expanded its operational environment to the point where sorties amounted to a total of 20,000

into mid-May. Less than 3000 of these took place in Ukrainian-controlled airspace and, normally, close to its Ground Forces.⁴¹ Currently, the vvs is only able to fly 10 sorties per day, which is a significant reduction.⁴² Notably, Western analysts also assessed that Ukraine was the second-densest air defence environment in Europe, with approximately 250 S-300s in operation, now complemented by Western support in the form of MANPADS, such as IGLA-S, Stingers and Starstreaks, along with additional GBADs and SAM systems. Had it not been for its ability to disperse tactical aviation from major bases and temporarily maintain its aircraft in the field, repairing them when needed, it is highly likely that the Ukrainian Air Force would not have survived the opening phases, as technologically it remains completely outmatched and outnumbered.⁴³

Observable tactics and flaws

While operating its Soviet-made mobile SAM systems, Ukraine utilised the tactic of mobility and dispersion, enabling these systems to survive the first wave of strikes and raising the risks for vvs fast jets operating above low altitude in Ukrainian-controlled airspace.⁴⁴ Russian attempts to conduct day sorties at low altitudes during the first week of March 2022 led to at least 10 fast-jet losses.⁴⁵ As Ukrainian MANPAD crews experienced targeting difficulties during night-time, in early March the vvs shifted its penetration sorties to night attacks, which initially reduced material losses. But only the Su-34 had the technical equipment and its operators the relevant training necessary for low-level night operations,⁴⁶ bearing therefore the strain of conducting such penetration strike operations for some time before they were finally drawn down in April.⁴⁷ In Syria, Su-34s reportedly deployed GLONASS-guided munitions, such as the KAB-500S-E⁴⁸, a smart bomb, and the Russian equivalent of a Joint Direct Attack Munition (JDAM), which turns an unguided bomb into an accurate GPS-guided one.⁴⁹ However, in the first two months of the full-scale invasion, the bulk of Su-34s carried out strikes with unguided munitions intended for ground attacks. The Su-34 is also the vvs's most adept user of PGMs, which raises questions as to why the vvs draws down on the number of PGMs, relying instead on unguided munitions: Is the vvs running low on PGMs, or is Russia saving them for a much bigger war?⁵⁰

Flying at low altitudes nevertheless remains challenging, creating additional layers of fatigue for the pilot – especially for older ones – and limited sight time for detecting and engaging targets with precision. This led to change in the general targeting profile. Throughout

the first six months, the vvs also struck urban population centres as well as targets that make little sense in terms of their tactical and strategic value.⁵¹ This is perhaps given the need for symbolic progress following the failed bid to seize Kyiv, which resulted in the reorganising of Russian Ground Forces and their conducting renewed operations against Ukrainian forces in Donbas, eastern Ukraine, and south-eastern Ukraine, where it combined both close air support and stand-off strikes from Russian territory.

Military analysts from the Royal United Services Institute (RUSI) also assessed that Russia held local air superiority along a 200-km stretch close to the Russian border and in temporarily occupied Ukrainian territories with friendly forces on the ground.⁵² Round-the-clock bombardments of besieged Ukrainian cities near the immediate Russian airspace, such as in Mariupol, in south-eastern Ukraine, remain a clear illustration of this development. The bombing of Azovstal, in Mariupol, included unguided bombing runs by TU-22MR long-range aviation bombers, displaying a general sense of either recklessness, or a large appetite for risk, since Russia was deploying its 120-ton supersonic bombers within the range of Ukrainian GBAD and SAM systems.⁵³ While the presence and density of Russian GBAD systems in these areas force Ukrainian pilots to fly at lower altitudes,⁵⁴ Ukrainian MiG-29 pilots have specifically trained for low-altitude operations, given their understanding of Russian anti-aircraft systems, the ground environment, and concerning their own technical disadvantages when facing Russian aircraft.⁵⁵ As Ukrainian medium-range SAMs operate further away from these front lines, the vvs retains a far safer freedom to operate at higher altitudes.⁵⁶ But as of mid-April, and given the integrated network and the sheer density of GBADs or medium-ranged SAM systems in Ukraine, and previous losses in terms of aircraft, vvs fixed-wing aircraft no longer penetrate beyond the front lines and deeper into Ukrainian territory. Instead the Su-34 have often deployed laser-guided Kh-29T/L TV/laser-guided missiles for stand-off attacks from Russian-controlled territory, from medium altitude, at distances of 8–15 km, against fixed targets.⁵⁷

The activity of the vvs was restricted to limited single or double sorties in Ukrainian airspace. The majority of sorties were conducted in daylight, at medium altitude, and carried out by single aircraft; fewer than 25 percent were strikes conducted by pairs or larger formations, with not more than six aircraft involved.⁵⁸ Strikes were predominantly launched outside of Ukrainian airspace and Russia's only fifth-generation Su-57 stealth

fighter was also used for such stand-off strikes.⁵⁹ But initially, Su-34 frontal bombers equipped with multiple unguided bombs, along with Su-30M and Su-35S multi-role fighters, reportedly outmatching Ukrainian fighter aircraft, technically speaking, flew around 140 CAPs per day in the period covering the end of February to the first week of March, and up to 300 km inside Ukrainian territory, at altitudes ranging from 3700 to 9200 m.⁶⁰ Some of the main targets were Ukrainian air defences, fixed long-range radar installations, and munition storages. Most of these medium- to high-level strikes had earlier been pre-designated by Su-24MR reconnaissance bombers.⁶¹

Facing the Su-30SM and Su-35S multi-role fighters, Ukraine remains aware of its technical inferiority in the air-to-air domain: Russia's R-77-1 medium-range air-to-air missile can home in on targets independently, thanks to its active radar-seekers and, notably, it outmatches Ukraine's R-27R, which has a semi-active radar.⁶²

Russian GBAD systems inside Ukrainian territory, such as the 9K330 Tor SAM and 9K317 medium-range BUK system, were initially also advancing out of sequence, often separated from their formations, which they were supposed to protect. They also operated in an operational environment under restrictive rules of engagement, with the assumption that anything that flew was Russian.⁶³ This meant that fixed-wing aircraft retained the freedom to fly significant distances across rapidly changing front lines. But these settings shifted in March, when both sides reorganised their respective SAM/GBAD systems.⁶⁴

Additional operational tactical flaws concern the flow of communication between Russian Ground Forces and aerial assets, which has been far from optimal in the combat environments in Ukraine. While the VVS's initial aim was set on Ukraine's air defence infrastructure, VVS air operations remain after the first six months subordinated to the needs and priorities of the Ground Forces and the tactical challenges facing them, thereby minimising in turn the levels of sorties in the deeper echelons of Ukrainian air space. The coordination of aerial operations are also not managed by a centrally combined air-operations centre, but instead by Ground-Based elements.⁶⁵ As regards receiving aerial refuelling, which can grant aerial elements heightened readiness while transiting to the area of operations, the VVS fighter fleet remains down-prioritised in comparison to strategic aviation.⁶⁶ This downgrades the VVS's ability to maintain frequent patrols and to provide lengthy close air support to Ground Forces. Aerial refuelling would also not be feasible given the considerable risks associated with

flying in the small operational aerial pockets threatened by Ukrainian GBAD or SAM systems.

While only the Su-24/34 may have been considered "the main work-horses" in Syria, the VVS has employed all types of aircraft in Ukraine in multiple roles. The continued threat from Ukrainian SAM, GBADs and MANPADs engagements along the fluid battlefields, and especially taking into account previous losses, has significantly shaped the behaviour of Russian pilots and constrained their appetite for risks when penetrating deep into Ukrainian territory. The VVS has thus also been forced to rely more on its limited stockpile of PGMs.⁶⁷ This is also acknowledged by the well-known Telegram Channel Rybar, which on September 24, 2022 questioned why, despite the technical and organisational advantages of the VVS, Ukrainian GBADs were still not being suppressed.⁶⁸ The Ukrainian air force has also successfully integrated the Western-supplied AGM-88 High-Speed Anti-Radiation (HARM) Missile with its MiG-29 fighter jets, resulting in the successful attrition and suppression of Russian GBAD systems.⁶⁹

Operational factors that reduce the scale and complexity of VVS operations also touch on the Russian tendency to assign the most dangerous missions to experienced crews: the level of attrition hampers the effectiveness of training new pilots. The VVS entered the conflict with less than 100 trained pilots, and Ukrainian authorities note that Russian pilots remain well sought after during prisoner exchanges.⁷⁰ Prior to the war, they were also assessed as logging 80–100 flight hours annually, a small number compared to NATO standards, which raises the question of whether such hours are sufficient for the realities of modern air combat.⁷¹ Mobilising experienced Russian flight instructors from aerial academies depletes the potential and capabilities for educating younger pilots: older pilots have either ended up captured or killed. The poor mission planning before the invasion also forced ill-prepared pilots to face unnecessary risks, such as having to fly with commercial and unsecure navigation systems.⁷²

In October 2022, Russia's former battlefield commander in Ukraine, General Sergei Surovikin, who the Kremlin appointed on 8 October 2022 and then finally replaced on 11 January 2023,⁷³ highlighted that between February 23 and October 17, 2022, Russia's Operational, Army, and Long-range aviation had conducted 34,000 sorties, with 7,000 guided munitions.⁷⁴ Statistics presented by the Russian MoD could very well be overinflated, especially given the operational factors raised above, such as risks associated with pilots' being equipped with old maps, a shortage of trained radio

operators, difficulties in low-level navigation, target recognition problems and the challenges in conducting bold, daylight, low-level sorties, in poor weather conditions, with unguided munitions that cause insignificant results. Notably, the additional deficiencies in conducting battle damage assessments (BDA) relied on three factors: a) pilots confirming that they engaged and struck the target, b) satellite imagery that displayed the damage, and c) signal intelligence (SIGINT) that depended on whether the Ukrainians actually reported the strike and the damage it caused.⁷⁵ When relying on these factors, especially on false SIGINTs that the Ukrainian side deliberately implemented, the VVS's BDA fell for Ukrainian deception and thus targeted non-existent or even insignificant targets. A telling example is the failure to follow up on prior strikes on Ukrainian airfields.⁷⁶

The results of these operational factors in Ukraine have initiated an intense and ongoing debate within the Russian military blogger community, which has throughout the war scathingly criticised the Russian General Staff and the MoD for incompetence and neglecting the lessons learned in Syria.⁷⁷ These factors have limited VVS operations over Ukrainian-controlled territory, where the VVS is instead employing stand-off strikes, against targets in deeper Ukrainian territory, with a mix of cruise/ballistic missiles, at high altitudes, or at night. It remains imperative to note that neither Russia nor the Soviet Union ever conducted a Suppression and/or Destruction of Enemy Air Defences (SEAD/DEAD) operation,⁷⁸ notwithstanding the fact that the first set of strikes against Ukrainian airfields and AD installations led military analysts to assume that it was the start of a SEAD campaign.⁷⁹ The aerial campaign in the Syrian intervention had also led one to assume that the VVS would conduct independent sorties, free from the constraints of being subjugated to the Ground Forces. This assumption proved wrong, as the first six months in Ukraine displayed that there was no doctrinal change in Russia's application of tactical air power in the war against Ukraine: the VVS continues to remain a subordinate echelon to the Ground Forces.⁸⁰

FIXED-WING LOSSES IN THE AERIAL WAR

Based on numbers obtained from Ukraine's Ministry of Defence (mid-Nov. 2022), the VVS had sustained 269 fixed-wing losses, while Oryx Open Source reports 63.⁸¹ Other sources refer to the loss of 30 combat aircraft.⁸² While these numbers remain impossible to verify, and caution should be drawn in reaching conclusions based on open-source intelligence, they may provide an indication and complement primary and secondary sources

on the question of the extent to which both sides have endured visible losses of fixed-wing aircraft. Few losses that are a result of air-to-air combat are recorded by either side, and the majority of them could be attributed to losses sustained by GBAD's. Moreover, in August 2022, the Russian MoD claimed that it had destroyed 278 Ukrainian combat aircraft, a number that is greater than the quantity of aircraft that Ukraine actually has.⁸³

CONCLUDING REMARKS AND DISCUSSIONS

Following the 2008 war in Georgia, the VVS reformed, and received significant experience during Russia's military intervention in Syria in 2015, although this was in combat environments against non-regular forces who neither possessed formal air forces nor advanced AD capabilities. A variety of operational factors during the first six months of the war against Ukraine have challenged the VVS, resulting in approximately 70 fast-jet losses, which also reveals structural deficiencies within the VVS's organisation. Some of the other main takeaways are:

- The imbalance of power between Russia's and Ukraine's respective air forces in practically every sense led to pre-war assumptions that an aerial war would be to Russia's advantage. But Ukraine's mobile and flexible GBAD and SAM systems denied Russian fixed-wing aircraft the ability to operate at higher altitudes early on in the war. Russia initially suppressed these systems but they were not degraded and survived thus the first wave of strikes, and reengaged Russian fixed-wing aircraft. As of March 2022, the VVS had lost the ability to conduct operations in Ukrainian-controlled airspace but today remain a threat near frontlines. Flying at lower altitudes was fraught with threats given the saturated MANPAD environment.
- Another crucial factor concerns how the Ukrainian air force dispersed to temporary air bases prior to 24 February. The VVS has primarily engaged pre-designated targets in Ukraine with unguided ordnance, launched from Russian-controlled airspace. They remain lethal primarily in areas close to the front lines, near the Russian border, and in temporarily occupied Ukrainian territory. The number of VVS sorties has fallen from approximately 300, in the initial phases, to currently just 10 missions per day.
- As the war has dragged on, the VVS has undoubtedly become tied to the tactical challenges facing the Ground Forces, in turn minimising the depth

of penetration into Ukrainian territory and the logic of prioritising air targets.⁸⁴ The performance in Ukraine, despite independent aerial operations in Syria, has again unveiled that Russian tactical air power continues to be Army-centric. Additional operational factors impeding on the VVS's capabilities and the scale and complexity of aerial operations also concern an insufficient dynamic targeting capability, limited flight hours for VVS pilots, and deficiencies in conducting Battle Damage Assessments (BDA). These operational factors have not only been analysed in the Western military analytical community, but also in Russia, where the aerial war and observable deficiencies in the VVS are intensely debated and questioned by both military analysts and bloggers. Moscow learned lessons from its aerial engagements in both Georgia

and Syria. The outcomes of the Syrian expedition remain intensely debated, and it remains to be seen whether Russia is able to draw tangible lessons from the aerial war against Ukraine.

- Given the inherent dangers associated with flying deeper into Ukrainian airspace, high-risk helicopter missions remain one of the few main options available for providing close air support to Ground Forces. As such, additional studies concerning the aerial domain could possibly examine the role of Russia's Army Aviation, which primarily consists of the Ka-52 Alligator, the Mi-28, and Mi-24/35 helicopters.⁸⁵ All were notable during the first phase of the full-scale invasion, especially during the failed attempt, via aerial assault, to seize the Hostomel airbase, in the northern outskirts of Kyiv.

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