

# Naval Drones: Lessons of the Ukraine War

## 1. Introduction

This study examines the operational use of unmanned systems as demonstrated during the Ukraine conflict, and how their employment has redefined the role of drones in modern naval and maritime operations. While the conflict provides the primary empirical foundation, the study also includes limited and disciplined discussion of emerging concepts that build directly on observed outcomes. Any forward looking analysis is grounded in demonstrated behavior rather than speculative technology leaps.

The Ukraine conflict represents the first sustained modern war in which unmanned systems were employed continuously at scale against a capable and adaptive adversary. Drones were not confined to reconnaissance or auxiliary roles. They were used as primary tools for detection, targeting, deception, disruption, and attack across air, surface, and subsurface environments. In the maritime domain, these systems altered fleet behavior, constrained freedom of maneuver, reshaped basing decisions, and imposed asymmetric costs without reliance on traditional naval parity.

Rather than treating unmanned systems as individual platforms, this study approaches them as functional capabilities applied across several operational fields. These fields include intelligence, surveillance, and reconnaissance; electronic warfare attack; electronic warfare decoy and deception; and loitering munition and strike operations. In addition, the conflict demonstrated the growing importance of drones in target cueing, battle damage assessment, communications relay, and defensive saturation. These roles often overlap and reinforce one another, forming an integrated unmanned layer that operates alongside conventional forces.

The study acknowledges that some of the most consequential lessons from Ukraine point toward systems that are still evolving or not yet fully fielded. Concepts such as distributed drone launch, recovery, and sustainment architectures are discussed at a high level to illustrate how navies may translate observed drone effectiveness into enduring capability. These discussions are intentionally broad and avoid technical specifics, focusing instead on operational logic and force design implications.

The sections that follow analyze how unmanned systems were employed, how defenders adapted in response, and how these interactions reshaped maritime operations. The central issue is not whether drones will be used in future naval conflicts, but how their demonstrated roles in Ukraine have already redefined expectations for persistence, risk acceptance, and the distribution of combat power in contested maritime environments.

## 2. Ukraine Drones

The Ukraine conflict represents the first modern war in which unmanned systems were employed continuously across all domains. Air, land, maritime, and subsurface drones were integrated into daily operations and adapted in real time in response to enemy defenses. Their use was not episodic or experimental. Unmanned systems became a persistent operational presence that shaped tactics, force posture, and decision making at every level of the conflict.

Across the battlespace, drones enabled detection, targeting, strike, deception, and assessment functions that were previously dependent on manned platforms or high value assets. Small, expendable systems provided intelligence, surveillance, and reconnaissance in

environments saturated with air defenses and electronic warfare. Loitering munitions and one way attack drones delivered precision strike effects against vehicles, air defense systems, logistics nodes, and fixed infrastructure. Electronic warfare attack and decoy drones disrupted sensors, consumed interceptors, and degraded command and control.

The defining characteristic of drone employment was persistence rather than survivability. Platforms were launched with the expectation of loss. Replacement was rapid, and operational tempo was maintained despite high attrition. This shifted the cost and risk calculus away from platform preservation and toward continuous pressure. Tactical success was achieved through repetition, coordination, and adaptation rather than individual mission success.

These effects extended into the maritime domain without requiring traditional naval parity. Unmanned systems operating from land and sea constrained the movement of surface combatants, limited access to ports and coastal infrastructure, and forced defensive postures on superior naval forces. The threat environment became continuous rather than situational. Sea denial was imposed through the accumulation of risk rather than direct control.

Precision strike effects were achieved without manned aircraft or surface combatants operating in contested waters. Persistent ISR supported targeting and battle damage assessment in littoral zones despite countermeasures. Psychological and operational pressure on surface forces increased as commanders were forced to assume constant threat from low cost, difficult to detect systems.

Cost exchange ratios consistently favored the side employing unmanned systems. Low cost platforms forced disproportionate defensive investment in sensors, interceptors, patrols, and force protection measures. Attrition of unmanned systems was absorbed without operational collapse, while defensive responses imposed lasting constraints.

These outcomes were achieved despite limited resources, constrained industrial capacity, and the absence of air or maritime dominance. Unmanned systems functioned as an integrated layer across domains, reshaping how control, denial, and influence were exercised in contested environments.

Control of the sea was not required to deny its use.

### **3. Russian Drone Defense**

Russian forces did not respond to unmanned threats passively, nor were defensive failures the result of neglect or incompetence. Defensive measures evolved over time and reflected a serious effort to counter persistent drone activity across air and maritime approaches. The response was layered, adaptive, and increasingly resource intensive.

Layered defenses were established around key ports, anchorages, and coastal approaches. These included patrol craft, physical barriers such as booms and nets, coastal sensors, radar and electro optical systems, and a range of weapon systems from small arms to missile based air defense. Defensive coverage was extended seaward through patrol patterns and escorted transits, while ports were hardened to reduce vulnerability to surprise attack.

Defensive adaptations occurred repeatedly as new tactics were observed. Patrol density increased. Engagement rules were adjusted. Sensor coverage was expanded and repositioned. Barriers were reinforced or reconfigured. Escorts became more common for high value vessels, even within nominally secure waters. These changes indicate an active defensive posture responding to a real and persistent threat.

Despite these measures, defense imposed a continuous operational burden. Patrols required crews, fuel, and maintenance. Sensors demanded constant monitoring. Weapons

systems remained on alert for extended periods. Port operations slowed due to inspections, restricted movement, and heightened security procedures. Even when interceptions were successful, they consumed time, attention, and resources that could not be redirected elsewhere.

The critical insight is that successful interception did not equate to defensive success. Each engagement still imposed cost, manpower demands, and operational disruption. Defensive systems designed to defeat limited or episodic threats struggled to scale against persistent unmanned activity. As drone employment increased in frequency and coordination, the burden on defenders grew disproportionately.

Defense against unmanned systems proved inherently reactive. It required continuous presence and readiness, while attackers could choose timing, direction, and tempo. This imbalance favored persistence over protection and exposed the limits of traditional defensive architectures when faced with sustained, low cost, and expendable threats.

Russian drone defense efforts reduced losses and forced adaptations by attackers, but they did not eliminate the underlying pressure. The requirement to defend constantly became a defining operational constraint, shaping behavior and limiting freedom of action even in areas under nominal control.

#### **4. Modern Ship Drone Usage**

Current naval drone employment reflects a fundamentally different set of assumptions than those demonstrated in the Ukraine conflict. In most Western navies, unmanned systems are treated as supplemental capabilities rather than as primary operational tools. They are valuable, but limited, and are expected to be preserved rather than expended.

Shipboard drones are typically integrated as add on systems rather than as core design elements. Quantities are small, often measured in single digits. Missions are heavily weighted toward intelligence, surveillance, and reconnaissance, with limited provision for strike, electronic warfare, or decoy roles. Logistic support is fragile, relying on specialized spares, dedicated technicians, and low tolerance for loss.

Launch and recovery impose significant constraints. Weather limits flight and deck handling. Crew workload increases during flight operations, often competing with other mission demands. Deck availability restricts simultaneous aviation, recovery, and surface operations. These factors collectively reduce sortie rates and favor cautious employment.

Attrition is generally not assumed or planned for. Loss of a drone is treated as an exception rather than as an expected outcome. Replacement often requires port access, specialized maintenance, or external resupply. As a result, commanders are incentivized to minimize risk rather than to maintain persistent pressure.

This approach contrasts sharply with drone employment in Ukraine. There, unmanned systems were treated as consumable assets. Losses were anticipated, absorbed, and used to inform rapid adaptation. Scale, persistence, and turnover mattered more than platform longevity. Operational effect was achieved through repetition and coordination rather than through preservation.

The architectural implications are significant. Systems designed around limited drone quantities and fragile support chains struggle to replicate the effects demonstrated in Ukraine. Without built in assumptions of attrition, rapid replacement, and sustained launch capacity, modern ships are structurally constrained in how unmanned systems can be employed under combat conditions.

## **5. Future Fleet Drone Usage**

Observed patterns from Ukraine and current naval limitations point toward several likely trends in how unmanned systems will be employed by future fleets. These trends reflect extensions of demonstrated behavior rather than departures into unproven futurism. The emphasis is on operational practicality, not technological novelty.

Higher sortie rates are likely to become a baseline expectation. Persistent pressure requires frequent launch, rapid turnaround, and the ability to operate multiple unmanned systems simultaneously. This places greater importance on launch capacity, recovery throughput, onboard stowage, and sustainment rather than on individual platform endurance.

Unmanned systems will increasingly operate with greater autonomy under degraded or intermittent communications. This does not imply independent decision making, but rather the ability to continue assigned tasks, navigate, and execute preplanned behaviors when links are disrupted by electronic warfare or terrain. Resilience to loss of connectivity becomes as important as bandwidth or range.

The operational roles assigned to drones are likely to expand beyond intelligence, surveillance, and reconnaissance. Anti submarine warfare, strike, deception, and screening functions are natural extensions of capabilities already demonstrated. In these roles, drones act as sensors, decoys, and expendable effectors that shape the battlespace ahead of manned platforms.

Loss will be treated as a normal condition rather than an exception. Persistent unmanned operations assume attrition and plan for replacement. Operational success depends on the ability to absorb losses without reducing tempo or effectiveness. This shifts emphasis away from platform survivability and toward inventory depth, rapid replenishment, and simplified support.

The defining shift is not autonomy, but scale and persistence. The ability to deploy unmanned systems in quantity, sustain their use over time, and integrate them into routine operations will matter more than individual platform sophistication. Fleets that embrace this shift gain flexibility and impose continuous pressure. Fleets that do not remain constrained by preservation oriented assumptions.

## **6. The Need for Built-In Capability**

Unmanned systems can no longer be treated as auxiliary capabilities or optional enhancements to existing platforms. Their demonstrated use in Ukraine shows that drones function as a persistent operational layer, shaping the battlespace through continuous presence rather than episodic employment. This shift requires a fundamental redefinition of their role within naval forces.

Traditional naval design assumes that primary combat power resides in manned platforms, with unmanned systems serving in support. This assumption drives how ships are built, how crews are organized, and how operations are planned. Drones are embarked, launched when conditions permit, recovered if possible, and stored when not in use. This model prioritizes preservation and control over tempo and pressure.

The conflict in Ukraine demonstrated a different approach. Unmanned systems were treated as consumable elements of combat power. Their value derived from frequency, repetition, and coordination rather than endurance or survivability. Loss was expected and absorbed. Effect

was measured in pressure applied, not platforms preserved. This distinction is not philosophical. It directly influences how systems are designed, sustained, and employed.

Redefining the drone role shifts the emphasis from carriage to generation. Unmanned systems must be produced, prepared, launched, recovered, assessed, and regenerated as part of continuous operations. This requires internalized unmanned workflows that are protected, efficient, and independent of deck availability or favorable weather. Integrated handling becomes essential, as does the ability to move systems from stowage to employment and back again without interrupting other ship functions.

Architecture becomes the enabling factor. Dedicated volume supports scale. Protected maintenance spaces enable rapid turnaround. Sufficient power and data capacity allow concurrent operations rather than sequential use. Workflow design determines whether drones are employed in bursts or maintained as a persistent layer. These are not optional optimizations. They define whether unmanned systems can be used at the tempo observed in Ukraine.

Retrofitting these functions into ships designed for different assumptions imposes hard limits. Space is finite and often fragmented. Survivability zoning restricts movement and activity under threat. Crew efficiency degrades when unmanned operations compete with aviation, weapons handling, or damage control for the same physical and cognitive resources. Procedural changes cannot fully overcome architectural mismatches.

The distinction between carrying drones and operating them continuously is decisive. Systems that are merely embarked remain constrained by preservation oriented assumptions. Systems that are designed in as core operational elements enable persistence, accept attrition, and sustain pressure.

The most effective unmanned operations observed were enabled by systems designed around rapid deployment, recovery, and regeneration, rather than episodic use.

## **7.     Functionality of Drones in Naval Combat**

Unmanned systems derive their value in naval combat from how they are employed rather than from the individual characteristics of any single platform. Their effectiveness depends on persistence, coordination, and role specialization. When treated as functional tools rather than as generalized aircraft or vehicles, drones provide capabilities that are difficult to replicate with manned systems alone.

### **Persistent Intelligence, Surveillance, and Reconnaissance**

Drones provide persistent sensor coverage in environments where continuous manned presence is impractical or too costly. Their ability to loiter, operate in numbers, and accept attrition allows commanders to maintain awareness over wide areas for extended periods. In contested littoral zones, persistent ISR enables early detection, target tracking, and battle damage assessment despite active countermeasures. Redundancy and replacement ensure that the loss of individual platforms does not collapse situational awareness.

### **Electronic Warfare**

Unmanned systems enable directed electronic warfare through proximity rather than power. Instead of relying on exquisite emitters or high output jammers, drones can employ raw noise at close range to disrupt sensors, degrade communications, and blind defensive systems. These effects are decisive not because they are subtle, but because they are timely and persistent.

Electronic warfare delivered by expendable platforms reduces risk to manned assets and allows effects to be applied where and when they are most disruptive.

### **Decoy and Deception Operations**

Drones are uniquely suited to decoy roles due to their ability to simulate the signatures of higher value assets. By emitting radar, infrared, acoustic, or electromagnetic outputs, unmanned systems can multiply perceived targets or obscure the true disposition of forces. Decoys force defenders to allocate sensors, interceptors, and attention against false or ambiguous contacts. Even when identified as decoys, they still impose decision making burdens and consume defensive capacity.

### **Loitering Munition Employment**

Loitering munitions provide rapid response against time sensitive or smaller threats without the escalation associated with traditional missile launches. They offer a means to engage targets of opportunity, mobile systems, or lightly defended assets while remaining proportional and flexible. Their presence shortens the kill chain by combining detection and engagement within a single system, reducing reliance on centralized control or high value launch platforms.

### **Strike Munition Roles**

Strike munitions extend the reach of naval forces without requiring immediate commitment of major weapons systems. By delivering longer range effects through unmanned platforms, commanders gain options below the threshold of large scale missile employment. This allows pressure to be applied selectively, signals to be sent deliberately, and escalation to be managed more carefully. The expendable nature of these systems enables repeated use without exposing capital assets.

### **Integrated Employment**

These functions are most effective when employed together. Persistent ISR enables targeting. Electronic warfare and decoys shape the defensive environment. Loitering and strike munitions deliver effects at the chosen moment. When coordinated, unmanned systems form an operational layer that operates continuously alongside manned forces. Their role is not to replace traditional platforms, but to extend reach, absorb risk, and impose persistent pressure across the battlespace.

When drones are treated as functional elements within naval combat rather than as individual platforms, their value scales with quantity, persistence, and integration. This functional approach reflects how unmanned systems were most effectively employed in Ukraine and provides a practical framework for their use in future maritime conflicts.

## **8. A Fleet With Drones vs One Without**

The presence or absence of integrated unmanned systems creates a fundamental divergence in how fleets operate under contested conditions. This divergence is not a matter of efficiency or convenience. It defines how risk is distributed, how pressure is applied, and how quickly initiative is gained or lost.

### **Situational Awareness Persistence**

A fleet with integrated unmanned systems maintains persistent situational awareness through continuous sensing across wide areas. Loss of individual platforms does not collapse coverage because redundancy and replacement are built into operations. Awareness degrades gradually rather than catastrophically.

A fleet without unmanned systems relies on intermittent sensing from manned aircraft, ships, or external sources. Coverage is bounded by endurance, crew limits, and availability. Gaps are inevitable. Situational awareness becomes episodic, and uncertainty increases between sensing windows.

### **Risk Distribution**

Unmanned systems absorb risk by operating forward and accepting attrition. Detection, probing, and engagement occur without exposing high value platforms. Risk is spread across many low cost assets rather than concentrated in a few critical hulls.

A fleet without drones concentrates risk in manned platforms. Each sortie, patrol, or transit exposes crewed ships or aircraft to detection and engagement. Losses are less frequent but far more consequential. Risk cannot be distributed without committing major assets.

### **Cost Exchange Ratios**

Integrated unmanned systems consistently impose favorable cost exchange ratios. Low cost platforms force defenders to expend high value interceptors, dedicate patrol assets, and maintain heightened readiness. Even unsuccessful attacks impose cost through disruption and defensive consumption.

A fleet without drones engages in unfavorable exchanges by default. Threat detection and response rely on expensive platforms and munitions. Each defensive action carries significant cost, and the fleet has fewer low cost options to impose reciprocal pressure.

### **Crew Exposure**

Unmanned operations reduce crew exposure by shifting dangerous tasks forward to expendable systems. Persistent surveillance, electronic warfare, and strike functions can be performed without placing personnel in contested zones.

Without unmanned systems, crews must be committed earlier and more often. Manned platforms perform sensing, screening, and initial engagement roles, increasing exposure to detection and attack. Crew risk scales directly with operational tempo.

### **Operational Tempo**

A fleet with drones maintains higher operational tempo through continuous pressure. Unmanned systems operate independently of crew rest cycles and can be regenerated rapidly. Tempo is sustained even in the face of attrition.

A fleet without drones experiences tempo limitations driven by maintenance, fatigue, and risk management. Operations become cautious and episodic. Initiative is easily lost when assets must withdraw to reset or recover.

### **Denial Versus Control**

Integrated unmanned systems allow a fleet to impose denial without first achieving control. Risk, uncertainty, and disruption can be applied persistently without dominating the maritime domain.

A fleet without drones must seek control in order to impose denial. This requires earlier commitment of manned forces, greater escalation, and higher exposure. Denial becomes

conditional and difficult to sustain.

### **Final Takeaway**

A fleet without integrated unmanned systems must accept higher risk per hull. It must commit manned platforms earlier to achieve effects that unmanned systems can impose at distance. As a result, it loses initiative faster and operates from a reactive posture rather than a position of persistent pressure.

## **9. Conclusion**

The Ukraine conflict demonstrated that unmanned systems are already decisive in modern maritime operations. Their impact did not depend on technological novelty, exquisite platforms, or favorable conditions. It emerged from persistent employment, acceptance of attrition, and integration across operational roles. These effects are present now, not deferred to a future force.

Ships and fleets not designed to support persistent unmanned operations face a structural disadvantage. This disadvantage is not the result of doctrine, training, or procurement timelines alone. It is rooted in physical constraints. Limited volume, fragile workflows, constrained power and data capacity, and deck dependent operations restrict how unmanned systems can be employed under sustained pressure. These limits cannot be fully overcome through incremental upgrades or procedural adaptation.

The central issue is not adoption speed. Many navies already operate drones. The issue is architectural mismatch between how ships are designed and how unmanned systems must be used to achieve the effects demonstrated in Ukraine. Platforms built around episodic use and preservation oriented assumptions cannot replicate the persistence, scale, and resilience observed in combat.

As unmanned systems become a permanent operational layer, future fleets will diverge. Some platforms will generate unmanned effects continuously, absorbing risk, sustaining tempo, and imposing denial without requiring control. Others will remain increasingly exposed, forced to commit manned platforms earlier, accept higher risk per hull, and operate with declining initiative.

The lesson of the Ukraine war is not that drones are powerful, but that ships not designed to employ them at scale will be increasingly constrained by their absence.