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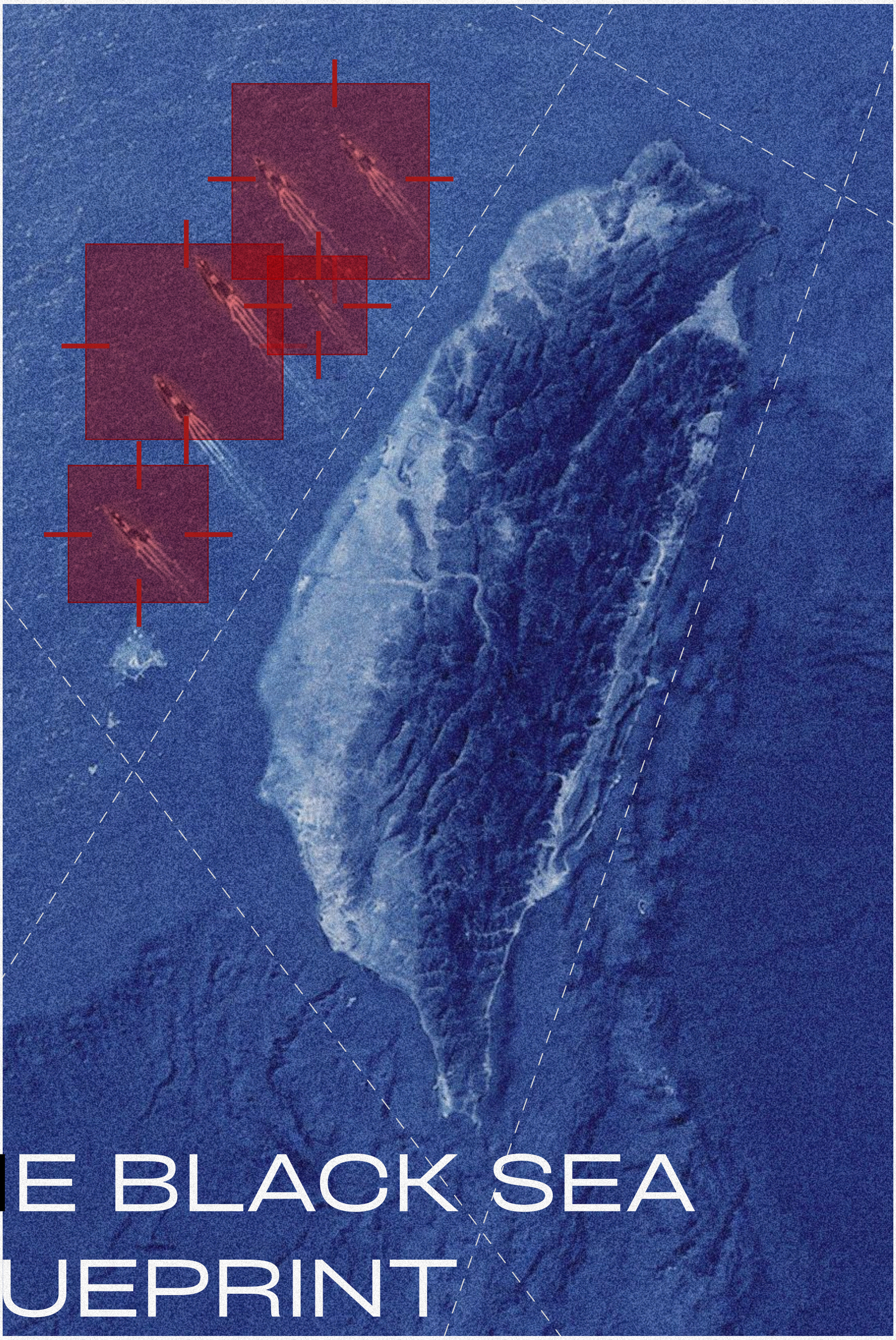

THE BLACK SEA BLUEPRINT FOR TAIWAN

UKRAINE'S NAVAL LESSONS IN ASYMMETRIC WARFARE

With thanks to our partner units and all of those who contributed to Ukraine's victory on the Black Sea, many of whom cannot be named at this time.

This report is grounded in their operational experience and shaped through interviews, field insights, candid feedback, and professional expertise.

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SNAKE ISLAND INSTITUTE

The Snake Island Institute is an independent defense analytics and coordination center established to strengthen the strategic partnership between Ukraine and its western allies in the security sector through:

ANALYTICS:

Advancing understanding of modern warfare and doctrine

INTERNATIONAL PARTNERSHIPS:

Aligning Ukrainian, U.S., and international decision-makers

DEFENSE TECH:

Enabling integration of critical technologies into combat operations

You can find more on our website.

snakeisland.org

This report is, in a lot of ways, a bit of a departure for us.

Snake Island Institute was built on the ground in Ukraine, by people who have spent the war studying it up close. Talking to operators, manufacturers, commanders, watching the tactics evolve in real time, and trying to make sense of what works and why. Our previous work has lived squarely in that world—this one does not. It asks what Ukraine's experience in the Black Sea means for a place we do not study every day, fought by a force we have not met, against an adversary whose scale and sophistication we have not seen.

We are not Indo-Pacific experts, and we do not pretend to be. There are people who have spent careers on the Taiwan Strait, on the PLAN, on cross-strait deterrence, and we have read them, leaned on them, and tried to engage their work seriously. What we bring is something different: for the first time, a major body of work has been built around hours of conversations with Ukrainian operators not just about their lessons learned, but about how they would approach a completely different theater.

The discipline we tried to hold here is to avoid a direct extrapolation of Ukraine's tactics and experience onto Taiwan. Rather, we tried to conduct a careful thought exercise. We know there are countless ways a conflict in the Indo-Pacific could—or could not—play out, and this report does not attempt to predict any of them. It examines a single scenario as a stress test for the Ukrainian model, nothing more. Some lessons from the Black Sea translate cleanly. Others demand significant adaptation. A few do not translate at all, and we have tried to say so plainly when that is the case.

This is our first major attempt to do this kind of work—to take what Ukraine has learned and offer it to another contingency. We think it matters. The mass proliferation of cheap, guided, attritable unmanned systems has emerged as the decisive military problem of this decade, and no country has been forced to confront it longer or more publicly than Ukraine.

Ukraine is no longer the fighting force it was four years ago. Its place in the global security architecture has decisively shifted, from recipient to contributor, and Taiwan is an interesting test case for this emerging alliance model. This report is a first foray in our exploration of Ukraine as a security exporter. We expect to get some things wrong. We welcome the criticism that comes with trying.

Catarina Buchatskiy

Director of Analytics,
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Executive Summary

Ukraine's fight against the Russian Black Sea Fleet has seen tremendous developments in the use of Unmanned Surface Vehicles (USVs), yielding valuable lessons for states facing outsized threats. As China continues to increase its pressure against Taiwan, these lessons have significant utility for the island's defense. In Taiwan's case, the value of USVs lies in their ability to close existing structural gaps in the island's defense, imposed by the extreme time compression of operations, early fleet degradation, asymmetric force size, and geographic isolation. While they are not "silver bullets" nor a substitute for conventional naval forces, USVs represent a cost-effective force multiplier. Without crew sustainment requirements, and with significantly lower maintenance demands than crewed platforms, unmanned systems can be produced at scale for a fraction of the per-unit cost. This enables a defending navy to sustain combat power, maintain domain awareness, and preserve forward presence at costs conventional forces cannot match; an advantage that becomes increasingly consequential under conditions of prolonged conflict and attrition. However, to successfully implement a USV strategy, Taiwan must address critical, unresolved industrial and logistical challenges.

Key Strategic Findings for Implementing a USV Strategy:

1. Mass Matters More Than Perfection

Chinese ships have powerful, layered defenses. To shape outcomes, drones need not be exquisite systems, but should instead be fielded in large numbers to overwhelm those defenses. Large numbers of low-cost attackers can force the enemy to choose between spending scarce, high-value interceptors or accepting losses against critical assets. Taiwan should therefore expect high attrition levels for its USV fleet, as more than half of a drone wave may be destroyed before reaching its target. To effectively achieve this tradeoff would require thousands of platforms.

2. Bad Weather is an Opportunity

The particular geography and meteorology of the strait should inform force employment to maximise the advantage of USVs and minimise their weaknesses. The rough conditions of the Taiwan Strait are often seen as an obstacle for drones. In reality, it is quite the opposite: on smooth waters, a drone's wake creates a high-contrast trail visible from high-altitude surveillance for dozens of kilometers. Heavy seas and poor visibility, however, provide essential opportunities for concealment. Stormy weather, and in some cases, darkness, may be among the few conditions under which USVs can approach high-value Chinese ships without being detected early by advanced radars and engaged at long range.

3. Leverage USVs Across Conflict Phases

The primary role of USVs is not to annihilate the PLAN fleet, but to provide persistent presence, sensing, and low-cost lethality that disrupt the invasion's timing, tempo, and force cohesion. As the campaign unfolds, different phases create different opportunities to exploit PLAN vulnerabilities.

- **Maritime Blockade:** USVs conduct diversionary attacks, persistent harassment, and mine deployment, forcing the PLAN to keep escorts on high alert and constantly shift positions. Rather than maintaining a stable blockade, the PLAN faces a high-risk environment that steadily drains its resources
- **Initial Sustainment After Landing:** USVs target the weakest link, the supply chain between sea and shore. Amphibious ships operate on tight schedules and must unload within narrow time windows, so even minor drone attacks can create "traffic jams" at sea. This disrupts or delays the flow of supplies, making it harder for landing forces to consolidate their positions
- **Port-Centric Logistics:** USVs exploit the vulnerability of ships docked in ports. Large vessels unloading heavy equipment are often stationary or moving slowly in confined waters, making them easy, high-value targets for massed drone strikes

In a campaign where every hour counts, these disruptions create constant friction. By slowing the flow of reinforcements and supplies, USVs can impose a slower operational tempo for the PLAN, and can determine whether the invasion force succeeds or collapses under its own logistical weight.

4. Align Industrial and Logistical Requirements to Support the Strategy

The effectiveness of this strategy depends on Taiwan's industrial and logistical capacity to sustain the tactical and operational demands of USVs.

- **Stockpiling:** Taiwan must establish a preliminary reserve of thousands of platforms, components, and materials. Current production goals reaching into 2030 represent the minimum requirement for a credible defense. Horizontal links between state defense agencies and private tech developers could bypass multi-year procurement cycles, allowing for continued adaptation
- **Logistics:** A massive, distributed, and hardened network of storage facilities is required to protect these thousands of units from pre-emptive missile strikes. Launching a sufficient volume of USVs to saturate defenses takes time, and will need to be executed under constant ISR and fire. Taiwan should leverage USV transportability and adopt decentralized storage
- **Command and Control Resilience:** Effective USV deployment will be contingent on maintaining reliable command and control under heavy electronic warfare and communications disruption. This requires secure links where possible, fallback options for degraded conditions, and the ability to execute pre-programmed missions when direct control is lost

The success of the USV model depends on Taiwan's ability to sustain operations under isolation. Without the industrial foundation to produce, store, and launch these systems in bulk, the tactical advantages of unmanned systems will be nullified by the scale and tempo of PLAN operations.

Introduction

This study is the second in a series of reports produced by the Snake Island Institute on the future of naval warfare. Our first report, The Black Sea's Asymmetric Blueprint (2025), analyzed Ukraine's use of USVs to limit the Russian Black Sea Fleet's freedom of action. Drawing directly from wartime operations, we argued that asymmetric warfare can be fought and won if a nation combines rapid innovation cycles and an industrial base to overpower the enemy with mass attritable systems. This follow-on report applies those combat-derived lessons to a different strategic context, namely the Indo-Pacific and Taiwan's possibility of replicating Ukraine's success in fighting an asymmetric war against China.

This report deliberately focuses its analysis on one scenario: a Chinese Amphibious force crossing the Strait and conducting a military landing on Taiwan. While a blockade, gray-zone pressures, and political coercion are widely seen as more likely Chinese strategies, an amphibious invasion remains the most dangerous course of action. It is the scenario that shapes military planning, wargaming, and alliance commitments. For these reasons, it serves as the necessary baseline for evaluating military capability and deterrence in our analysis.

A large body of existing research already examines invasion scenarios, ranging from political decision-making and escalation dynamics to detailed military simulations. This report does not seek to replicate that work. It uses established invasion scenarios as a baseline framework and asks how the introduction of a largely unexamined variable, namely small, attritable unmanned maritime systems, might alter key assumptions about naval campaign vulnerability, sustainment, exploitability, and operational risk.

Ukraine's experience proves that unmanned maritime systems, when integrated into broader operational concepts, impose disproportionate costs on larger naval forces and disrupt maritime operations. However, their implementation requires a heavy lift on the industry side to adapt and mass manufacture systems at a meaningful scale. It also requires operational integration with ISR and special operations. These conditions may not be replicable and/or present in Taiwan.

It is also important to note that while Ukraine's maritime campaign unfolded in a constrained theater, the Indo-Pacific is an open and expansive environment. Still, the decisive phases of an amphibious campaign would unfold in geographically constrained operational and tactical corridors, as amphibious forces must operate close enough to sustain short, secure, and defensible logistical lines. Here the People's Liberation Army Navy (PLAN) fields the world's largest fleet by hull count, supported by long-range strike systems, maritime aviation, and a growing amphibious force, exposing Taiwan to greater maritime threats than Ukraine faced in the Black Sea. This report does not argue that Ukraine's model can be directly exported to the Pacific. Rather, it examines where those lessons translate, where they require adaptation, and where they may not apply at all given the scale and intricacy of the Taiwanese theatre.

The report draws on open-source intelligence, primary interviews from Ukrainian USV operators and manufacturers, and authoritative assessments of military capabilities. The latter include RAND Corporation research on maritime and force-projection vulnerabilities (RAND RR-392) and studies produced by the Center for Maritime Strategy at the U.S. Naval War College. The analysis is conducted by researchers at the Snake Island Institute.

Chapter 1. The Crisis of Existing Invasion Models

Security dynamics in the Taiwan Strait have gained increasing attention in recent years. As China has rapidly expanded its military capabilities over the past decades, Taiwan's security environment has become more volatile.

This chapter draws on analytical wargaming, most notably the 2023 CSIS Taiwan conflict simulations, not as predictive forecasts of an inevitable war, but as structured stress tests of prevailing defense concepts.[1] The purpose of this section is to examine how these models conceptualize Taiwan's role in a cross-Strait conflict and to identify the structural vulnerabilities that repeatedly shape outcomes across a wide range of scenarios.

Within this analytical framework, Taiwan's role in the conflict is widely understood as primarily defensive. Across CSIS wargame iterations and related analytical literature, the central objective is not framed as the outright defeat of the invading force, but rather as the ability to endure long enough for external partners to intervene.

The defensive strategy, however, rests on a set of assumptions marked by uncertainty. Wargaming consistently demonstrates that several variables, many of them beyond Taiwan's direct control, are decisive in shaping the outcome of a cross-Strait conflict. The most crucial of them remains the United States' role: whether it intervenes at all, how rapidly, and with what means.

The CSIS scenarios are valuable less for their specific sequences of events than for the recurring patterns of failure they expose. Examining the uncertainties that consistently emerge across scenarios allows us to identify directions where the existing Taiwanese defense model may require further adaptation to remain effective. These include vulnerabilities of its conventional naval forces, the use of timing and logistics in the early stage of the invasion, and uncertainties related to the potential intervention by Taiwan's partners, the U.S. and Japan.

Vulnerability of Conventional Forces

A Chinese invasion of Taiwan in the late 2020s would most likely begin with a large-scale, coordinated strike against Taiwanese naval and air assets, as well as the command-and-control systems required to employ them effectively. Chinese doctrine explicitly allows for a highly concentrated first strike, and the People's Liberation Army (PLA) has developed the missile forces required to execute it.

Taiwanese surface combatants, constrained by aging air- and missile-defense systems and limited magazine depth, would be poorly positioned to survive a massed barrage of modern Chinese missiles. Simulations project that the majority of Taiwan's surface fleet would be destroyed or rendered inoperable relatively quickly. As a result, Taiwan's ability to contest maritime control using conventional naval forces would collapse early in the conflict.

Similar conclusions apply to the Taiwanese Air Force. Analytical studies and wargaming consistently project severe early aircraft losses. Any aircraft caught on the ground and not sheltered in one of Taiwan's two underground facilities would likely be destroyed. Even aircraft protected underground could be rendered ineffective if the runways and supporting infrastructure servicing those facilities were disabled. This approach closely mirrors Russia's early campaign in Ukraine in 2022, where strikes on airfields, logistics, and aircraft storage aimed not merely at temporary air superiority, but at preventing the reconstitution of the Ukrainian Air Force. In the first month alone, Russia destroyed at least 66 Ukrainian fixed-wing aircraft.

1. Mark F. Cancian, Matthew Cancian, and Eric Heginbotham, The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan (Washington, DC: Center for Strategic and International Security Studies, January 2023), csis-website-prod.s3.amazonaws.com

Timing And The Critical Early Opportunity Window

Under these conditions, Taiwan's defensive logic becomes acutely time-dependent. Early resistance will not aim to defeat an invasion outright, but slow the enemy's consolidation on land and keep the door open for outside intervention. The scale and timing of U.S. involvement therefore emerge as central variables shaping Taiwan's prospects, while remaining fundamentally uncertain.

External Isolation and Logistics

Unlike Ukraine, Taiwan cannot rely on sustained external resupply once hostilities begin. Its island geography becomes a decisive liability under blockade conditions. Most scenarios assume that China would impose maritime and air denial from the first day of the conflict. In this setting, external deliveries of weapons, fuel, spare parts, and ammunition would be effectively impossible for at least the first thirty days.[2]

Taiwan would therefore likely be forced to fight under conditions of near-total autarky, with its endurance constrained by pre-war stockpiles and domestic production alone. Classical defensive concepts that assume continuous reinforcement or replenishment are rendered irrelevant under these circumstances.

Uncertainty and Limits of U.S. Intervention

The outcome of Taiwan's defense concept rests on the assumption that the United States and regional partners would intervene rapidly and at sufficient scale to disrupt a Chinese amphibious campaign. Wargaming has repeatedly demonstrated how dependent Taiwan's survival is on these external actors, though much uncertainty persists around their willingness and ability to intervene in time.

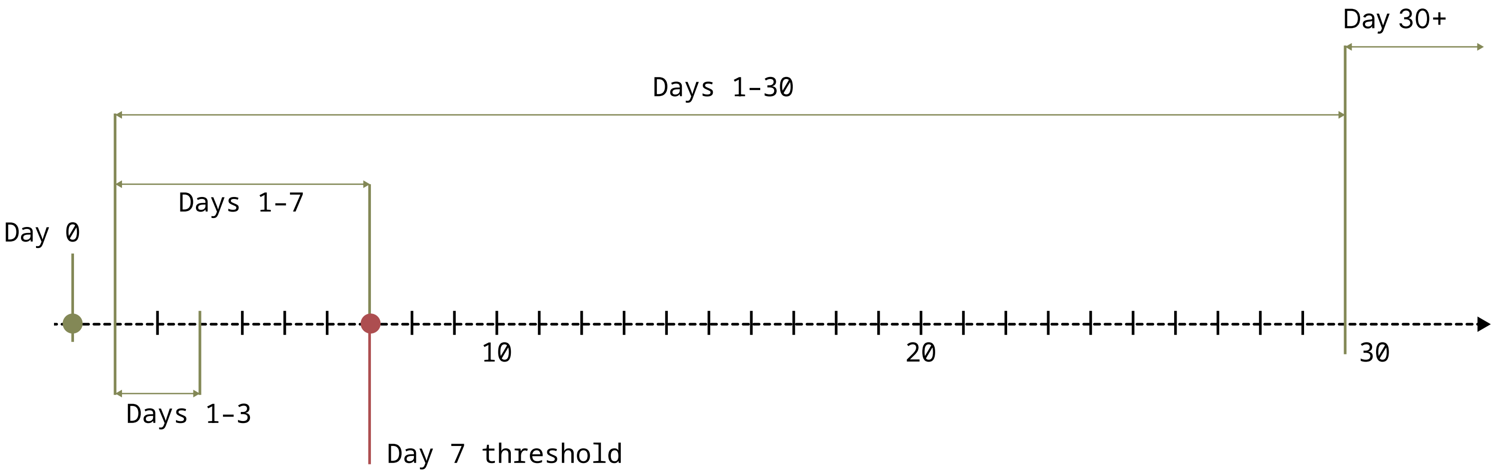
American decision-makers would face escalation with a near-peer and nuclear-armed competitor, putting at risk its bases in Japan and Guam and its naval assets operating inside the First Island Chain. Whether the political willingness to absorb these costs exists in Washington, D.C. should not be taken for granted. Japan faces similarly high costs should it choose to play a part in the conflict. While it would be central to a successful U.S. intervention, Japan's willingness to accept the associated risks is similarly uncertain.

As a result, Taiwan's defense concept depends heavily on variables outside its direct control. It is precisely for that reason that asymmetric and attritional approaches, such as the use of USVs, become strategically significant. They are means by which to rewrite the deterrence equation, threatening to impose a higher loss-exchange ratio in the event of an invasion while imposing a slower operational tempo on the PLAN, buying time and arguments for foreign intervention.

The following chapters will examine how USVs can be integrated into Taiwan's defense critical gaps, where they will be most valuable, how quickly Taiwan could adapt, and where the limits of this approach lie.

2. Erickson, Andrew S., Conor M. Kennedy, and Ryan D. Martinson. Study No. 8, Chinese Amphibious Warfare: Prospects for a Cross-Strait Invasion. CMSI Studies in Chinese Maritime Development, no. 8. Newport, RI: China Maritime Studies Institute, U.S. Naval War College, and Naval Institute Press, November 7, 2024. digital-commons.usnwc.edu

Taiwan conflict scenario 30+ days timeline



DAY 0
Invasion opens: large-scale coordinated strike

PLA executes a massed strike on Taiwan's naval assets, air assets, and command-and-control systems. Chinese doctrine allows for a highly concentrated first strike; missile forces are designed to execute it. Maritime and air denial is imposed from day one.

DAYS 1-3
Conventional forces rapidly degrade

Taiwan's surface fleet, constrained by aging air and missile defenses and limited magazine depth, is destroyed or rendered inoperable. Severe aircraft losses follow; any aircraft not sheltered in underground facilities is destroyed. Even protected aircraft are rendered ineffective if runways and supporting infrastructure are disabled. Taiwan's ability to contest maritime control collapses early.

DAYS 1-7
Critical early opportunity window

Taiwan's defensive logic becomes acutely time-dependent. The objective shifts from defeating the invasion to slowing PLA consolidation on land and keeping the door open for outside intervention. When early defensive lines hold, Chinese forces face severe constraints, their amphibious fleet becomes vulnerable.

DAY 7 THRESHOLD
U.S. intervention timing: critical threshold

If U.S. combat operations are delayed beyond the first week, China's amphibious fleet suffers less early attrition. This enables larger PLA forces to reach shore and improves prospects for rapid consolidation. U.S. forces are limited primarily to long-range standoff weapons (LRASM, JASSM-ER); dense Chinese air and naval defenses rule out sustained air superiority over the Strait.

DAYS 1-30
Near-total isolation: Taiwan fights under autarky

China imposes maritime and air denial from day one, making external resupply effectively impossible for at least the first 30 days. Taiwan is forced to fight on pre-war stockpiles and domestic production alone.

DAYS 1-30
U.S. ground forces cannot reach the island

Chinese air and naval forces rapidly isolate Taiwan, constraining maritime access and airlift. CSIS simulations conclude that the U.S. would be unable to deploy ground forces to the island during the first month of conflict, even if seriously considered. Japan's role, granting unrestricted base access and JSDF engagement, is critical but politically uncertain. U.S. bases in Japan are themselves vulnerable to Chinese ballistic and cruise missile strikes.

DAY 30+
Outcome shaped by amphibious fleet attrition

The campaign's result hinges on whether the PLA amphibious fleet was attrited in the early phase. The only viable path identified across CSIS scenarios is denying PLA consolidation via standoff strikes launched from beyond the Taiwan Strait and the First Island Chain. This currently places disproportionate weight on a small inventory of high-value munitions, underscoring the fragility of the overall approach.

Figure 1. Taiwan Invasion Scenario Timeline.

Taiwan's Strategic Evolution: The Internal Conflict of Doctrine

The vulnerabilities exposed by wargaming are not unknown to Taipei's defense establishment. However, building a resilient defense is limited by an internal dilemma: Taiwan's focus on traditional platforms conflicts with the need for an asymmetric, expendable approach essential to its survival. Taiwan's "Republic of China Navy" (ROCN) historically strived to rival the PLAN's capacity as an equal force. Given the PLAN's rapid expansion since the 1990s, however, the ROCN has been unable to keep pace.

The ROCN was built by, and continues to rely on, foreign-built vessels. However, due to China's global influence and the international "balancing act" of diplomatic relations with Taiwan, the military has repeatedly faced delays, denials, and cancellations while attempting to procure new systems. American arms imports are particularly important to Taipei, yet these are under strain. In 2024, the U.S. arms sale backlog to Taiwan rose roughly $2 billion to a high of $21.5 billion by February 2025. Rising costs, global supply chain disruptions and the diversion of Foreign Military Sales (FMS) toward the Middle East under the second Trump administration have also contributed to these delays.[3] As of writing, President Trump is set to decide on a $11 billion US arms package to Taiwan, including HIMARS and Javelin-missiles, following a visit to the PRC in May 2026.[4]

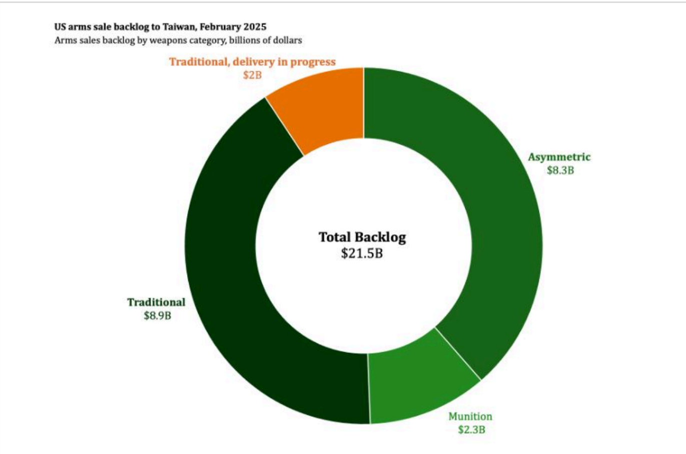


Figure 2. Taiwan Security Monitor. US Arms sale backlog to Taiwan, February 2025.[5]

Instead of developing a modern, innovative military, these problems have often forced Taiwan to operate outdated and underpowered systems. To reduce dependence on politically constrained foreign procurement and to modernize the force, Taiwan has expanded domestic programs to build key platforms at home.[6] Some examples include the Indigenous Defense Submarine (IDS) program, the Tuo Chiang-class stealth corvette, and domestically developed missile systems such as the Hsiung Feng series of cruise and anti-ship missiles.

In addition to their military utility, these programs are politically popular. To the Democratic Progressive Party (DPP), these ambitious programs represent a strong stance against CCP encroachment. To the Kuomintang (KMT), these programs are important steps to decrease Taiwanese reliance on U.S. and Western support. To many Taiwanese citizens, these advanced programs more broadly embody Taiwan's strength and national resistance. Nevertheless, competing visions for Taiwan's defense posture, budgetary constraints, and political infighting have all hampered progress. Moreover, fielding new platforms is only part of the challenge, while a key question remains whether Taiwan can develop the training infrastructure, operational doctrine, and institutional depth needed to employ these systems effectively under wartime conditions.

3. Eric Gomez, "Taiwan Arms Backlog, February 2025 Update: Early Trump Admin Arms Sales and Rumors of a Big Request from Taiwan," Taiwan Security Monitor (Schar School of Policy and Government, George Mason University), February 2025, tsm.schar.gmu.edu
4. Ben Blanchard, "Taiwan Says It Has Received No Information from U.S. on Delay to Second Arms Sale," Reuters, March 17, 2026, reuters.com
5. Gomez, "Taiwan Arms Backlog, February 2025 Update."
6. Raymond Kuo and Catherine Kish, "Taiwan's Will to Fight Isn't the Problem," War on the Rocks, September 5, 2025, warontherocks.com

These domestically produced systems are at the forefront of a clash between two competing visions for the future of Taiwanese defense. The first vision favors a traditional defense posture aimed at rivaling China's near-exclusive domination of surrounding waters. To counter China's increased "gray zone" tactics below the threshold of open war this school favors "high-profile, advanced, traditional platforms and weapons."[7] It recognizes that these long-term, large, and expensive projects are necessary to deter PLAN intrusion into Taiwanese airspace and territorial waters.

This approach is politically salient due to the public support of large, homegrown surface combatants and aircraft. This school also dominates the defense budget, as demonstrated by Taiwan's 2024–2025 overall defense spending. Conventional capabilities, such as F-16 fighter upgrades, indigenous submarines, and advanced air defense systems, accounted for an estimated 50–55 % of the total spending. Meanwhile, asymmetric programs like mobile anti-ship missiles, USVs, and precision rockets make up about 18–22 % of spending, with the remaining 25–30 % seemingly allocated to personnel, maintenance, logistics, and other essential support functions. Even while a multi-year special budget of NTD 1.25 trillion (USD 39.8 billion) has been approved to accelerate asymmetric capabilities, the bulk of public and government investment remains in these large, high-profile platforms, reflecting enduring emphasis on a traditional, visible deterrent.[8] It is important to note that these figures are necessarily estimates, as publicly available budget documents do not provide a precise breakdown of spending between conventional and asymmetric capabilities. At the time of writing, the parliament in Taipei is set to discuss the government's stalled bill on a $40 billion special defense budget.[9]

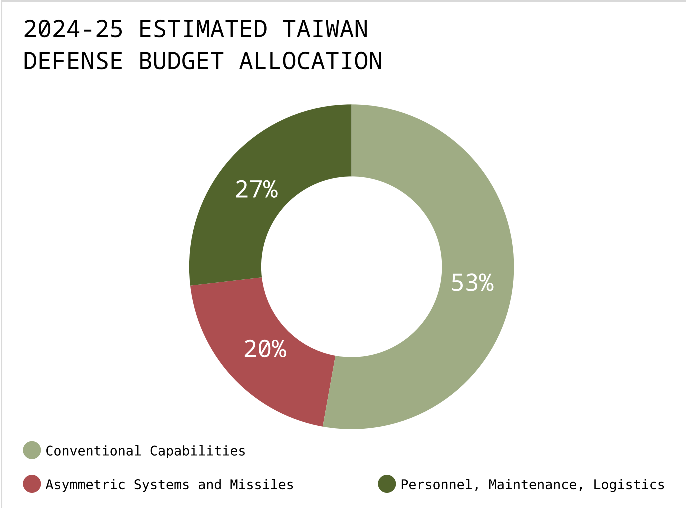


Figure 3. Taiwan's 2024-2025 defense budget allocation as percentages of total budget.

The other school of thought, as outlined in Admiral (ret.) Lee Hsi-min's "Overall Defense Concept" (ODC) in 2021, recognizes the limitations of a traditional naval buildup. He argues that while large, expensive platforms are necessary to counter gray zone activities, those same platforms would be easy targets during a full-scale Chinese invasion. This view is supported by the CSIS's assessment, and broad consensus now agrees that nearly all of Taiwan's large, traditional platforms would be destroyed or disabled during China's opening barrage. To counter the invasion scenario, Lee's ODC instead suggests an asymmetric approach which takes advantage of "large numbers of small, dispersed, mobile, and lethal weapons" which cannot be easily targeted by missile strikes but could effectively attrit the Chinese invasion fleet. These asymmetric systems include sea mines, fast minelayers, AI-enhanced micro missile assault boats, short- and medium-range precision munitions, man-portable air defense systems (MANPADS), and unmanned systems including USVs, UUVs, and UAVs.[10]

7. Lee Hsi-min, Taiwan's Overall Defense Concept: Theory and the Practice (Hoover Institution, September 27, 2021), 2, hoover.org
8. John Dotson, "Taiwan's New Special Defense Budget Emphasizes Indigenous Anti-Ship Weapons Production," Global Taiwan Institute, November 3, 2021, globaltaiwan.org
   Global Taiwan Institute, Global Taiwan Brief 8, no. 18 (September 20, 2023), PDF, globaltaiwan.org
   Army Recognition, "Taiwan plans major defense purchases for 2024 including Harpoon missiles and F-16 upgrades," August 27, 2024, armyrecognition.com
   Ministry of National Defense, Republic of China (Taiwan), "Ministry of National Defense Issues Press Release on 'Special Budget for Enhancing Defense Resilience and Asymmetric Capabilities'," Defense News, November 26, 2025, mnd.gov.tw
9. Ben Blanchard, "Taiwan parliament to discuss stalled special defence budget next week," Reuters, February 24, 2026, reuters.com
10. Lee, Taiwan's Overall Defense Concept, 2

This approach is highly reminiscent of the tactical innovations pioneered by Ukraine since 2022, where the use of MANPADS proved successful in the early days of the invasion.[11] Across the domains of air, land, sea, and the electromagnetic spectrum, Ukraine has compensated for shortages in traditional weaponry, such as artillery, by embracing unmanned systems with beneficial cost ratios. Thus, while countering Chinese aggression requires investment in large, traditional defense programs, Taiwan's ability to repel a full-scale invasion relies on its readiness to embrace an asymmetric strategy and adjust to the rapid, modern style of warfare demonstrated in Ukraine.

In recent years, and particularly under current defense minister Wellington Koo, the ROCN has taken steps toward integrating the ODC approach into the force structure. The 2025 edition of the Quadrennial Defense Review document released every four years which lays out the Ministry of National Defense’s (MND) doctrine and planned capabilities, embraces “constructing asymmetric capabilities” as one of its four principles of planned deterrence and sustainable capabilities.[12] It also calls for unmanned systems integration, with special focus paid to UAVs. Likewise, the MND has created the Defense Innovation Office (DIO), an entity based on the U.S. Defense Innovation Unit (DIU) and aimed at integrating new technology into the force structure. Tangible progress has been made too, as budget allocations to increase asymmetric capacities like anti-ship missiles and mines have yielded results ahead of schedule.[13] In August 2025, the MND also announced an increased procurement target of 100,000 UAVs over the next two years.[14,15]

Yet despite widespread calls for an asymmetric, innovative approach, the Taiwanese MND remains entrenched in traditional, platform-centric thinking. While the ROCN has embraced asymmetric capabilities in rhetoric, they remain tethered to the conventional fleet structure. Large-scale projects for legacy platforms are ongoing, and the integration of unmanned systems rarely goes past the surface level. For example, though the 2025 Quadrennial Defense Review discusses the need to develop UAVs (now a universally accepted talking point), the document fails to mention USVs or UUVs altogether. The MND has also failed to integrate critical technology that necessarily supplements the use of unmanned systems, such as electronic warfare (EW).[16] Unlike Admiral Lee’s vision for deep integration of asymmetry and innovation, Taiwan’s modernization process has lagged behind, hindered by entrenched bureaucratic thinking and poor budgetary allocation.

While Taiwan continues to debate the budgetary balance between traditional and asymmetric forces, a real-world “stress test” of the ODC has already taken place thousands of miles away. Ukraine, facing a similar maritime deficit, has moved beyond theory.

11. Sankaran, Jaganath. “How Ukraine Fought Against Russia’s Air War.” Center for International and Security Studies at Maryland, January 22, 2023. cissm.umd.edu
12. Ministry of National Defense, Republic of China (Taiwan). 2025 Quadrennial Defense Review. March 2025. PDF. http://bit.ly/4clhJOo
13. Harman, Jonathan. “Taiwan’s Missile Production Program: A Success Two Years Ahead of Schedule.” Global Taiwan Institute, October 30, 2024. globaltaiwan.org
14. Malyasov, Dylan. “Taiwan to buy over 100,000 military drones.” Defence Blog, July 30, 2025 (updated August 13, 2025). defence-blog.com
15. Liao, Chloe, and Sherri Wang. “Taiwan announces historic purchase of 100,000 drones in biggest UAV deal yet.” DigiTimes Asia, August 4, 2025. digitimes.com
16. Liao, Holmes. “Beyond a Budget Boost: Modernizing Taiwan’s Defense.” The Diplomat, March 12, 2025. thediplomat.com

Chapter 2. The Ukrainian "Blueprint": Asymmetric Response

For Taiwan to successfully learn from Ukraine, it is imperative to understand how Ukraine has conducted asymmetric warfare in the Black Sea. The following chapter explores the development of Ukrainian tactics and their results as a model of successfully countering an outsized naval threat.

In the early phase of the full-scale invasion, Ukraine relied on a small number of high-impact actions to disrupt Russian naval plans. The liberation of Snake Island, the sinking of the cruiser Moskva with a Neptune missile, and subsequent Harpoon strikes forced Russia to abandon amphibious landing plans and withdraw surface forces from the northwestern Black Sea.

These cases proved that Russian naval operations could be disrupted. However, they did not provide a scalable or sustainable mechanism for long-term maritime denial, nor did they ensure the continued protection and monitoring of the maritime export routes that Ukraine was hoping to open up. One-way attack USVs emerged as Ukraine's solution, combining precision, scalability, affordability, and most importantly, persistence as a means to maintain initiative on the waters.

Attrition in Attack Design

Fighting in the Black Sea throughout the Russo-Ukrainian War has made clear that attrition is not a byproduct of modern conflict but an intentional feature of it. While Russia has suffered devastating losses of major platforms, Ukraine has deliberately designed its defense for attritional warfare by manufacturing low-cost and easily replaceable platforms. Attrition means winning not by delivering a single decisive blow, but by making continued aggression too costly, both in resources and in will, for the adversary to continue. Because of the massive asymmetry that Taiwan faces against the PLAN, an attritional approach, as demonstrated by Ukraine, would be most effective.

Ukraine's highly successful use of USVs demonstrates the importance of incorporating attrition into attack design and prioritizing mass over technological perfection.

While one or two direct strikes by a USV is often enough to disable a warship, Ukrainian USV operators often employ groups of 10 or more USVs on a single operation. In some cases, an initial formation will separate to attack multiple ships simultaneously, whereas in others, the group is simply a tool of redundancy. A few key engagements show this best:

1. During the February 2024 attack on the Ivanovets corvette, ten MAGURA USVs were deployed simultaneously. While four USVs were drawing fire from the ship's defenses, the other six evaded the defenses and sank the corvette.[17]

2. In the February 2024 strike on the Caesar Kunikov landing ship, the Russian military claimed they destroyed four out of the ten attacking MAGURAs, while the remaining platforms achieved mission success.[18]

3. In a 2024 attack on four ships, including a Tunets patrol ship, seven USVs were destroyed by Russian defenses while at least four struck their targets.

17. Ataman, Joseph, Frederik Pleitgen, and Daria Tarasova-Markina. "A Ukrainian pilot outlines how drones powered by jet skis sunk a Russian warship." CNN, February 5, 2024. edition.cnn.com
18. Fighterbomber [@bomber_fighter], "Рубрика "Нам пишут". Здравствуйте товарищ ФБ! Экипаж БДК "Цезарь Куников" отражал атаку БЭКов всеми доступными силами и средствами, бой длился 20 минут. Из 10ти БЭКов было уничтожено 4 […]. ["'We hear from you' rubric. Hello, Comrade FB! The crew of the large landing ship (LLS) 'Caesar Kunikov' repelled an attack by naval drones (USVs) using all available forces and means; the fight lasted 20 minutes. Of 10 BEKs, 4 were destroyed […]"]," Telegram post, March 4, 2024, https://t.me/bomber_fighter/15913.
    Militarnyi. "З'явилося відео з борту десантного корабля «Цезарь Куников» під час атаки українських дронів" [Video from the landing ship Tsezar Kunikov during the Ukrainian drone attack was released]. March 6, 2024. militarnyi.com

Across many of these attacks, USV losses of approximately 40–50% have been considered acceptable in yielding successful operations. Such an approach is only viable when platforms are inexpensive, rapidly producible, and replaceable.

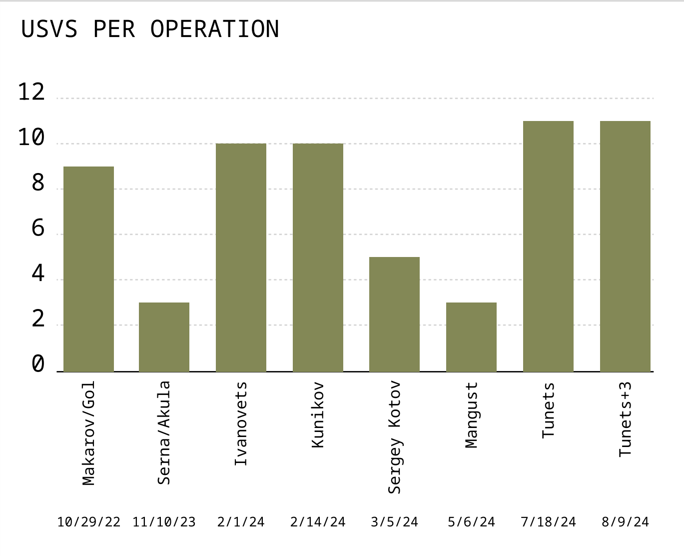


Figure 4. Minimum number of USVs used during several successful operations. Note that these are minimum figures confirmed by SII analysts, and more USVs may have been used.

This logic translates directly to Taiwan's strategic problem. Any large-scale Chinese amphibious invasion will necessarily accept losses. The critical question is how high of a loss-exchange ratio are they willing to endure, and for how long. Attrition of the Chinese fleet requires Taiwan to spend less than the adversary and replace losses faster than they can to outlast the Chinese cost-benefit equation.

The People's Liberation Army Navy (PLAN) amphibious fleet concentrates personnel and equipment in large, high-value platforms such as Type 071 landing platform docks, Type 075 amphibious assault ships, and roll-on/roll-off civilian vessels potentially mobilized for lift. These ships must arrive at a close distance to the shore to unload forces. If Taiwan deployed large numbers of attritable maritime drones from dispersed coastal sites, the planning equation for a cross-strait assault would change:

- Amphibious formations would need to defend against repeated low-profile surface threats during transit and approach
- Escort ships would expend defensive munitions at high rates
- Formation density might need to decrease, complicating synchronized landing timelines
- Transit windows, particularly at night or in marginal sea states, would carry persistent exposure risk
- The PLAN might also need to commit additional air cover, including elements of its limited carrier aviation, to protect the amphibious force, further straining scarce high-value assets

Even if the majority of attacking drones were neutralized, a small penetration rate against troop-carrying vessels could still produce disproportionate effects, as it did for Ukraine. Amphibious operations are inherently time-sensitive and sequence-dependent. Disruption during the approach phase – whether through damage, evasive maneuvering, or forced delays – can fragment landing waves, delay follow-on echelons, and undermine the coherence of the assault as a whole.

Cost Asymmetry and Its Effects

The principle of attritional warfare fundamentally relies on a cost asymmetry – expendable platforms must be inexpensive and easy to replace. While Ukrainian USVs vary in price, the MAGURA V5 used to sink the Russian missile corvette Ivanovets is valued at $250,000-$273,000. By contrast, the destroyed Ivanovets was valued at roughly $60–70 million. Thus, one drone represented less than 0.5% of the ship's monetary value. As individual systems, USVs sacrifice performance to achieve low costs. But fielded in adequate numbers, they are able to overcome the negative effects of this tradeoff.

Even though several drones were destroyed during the attack against the Ivanovets, the outcome of the exchange still greatly favored Ukraine.[19] In addition to the financial loss, the corvette's crew of over 30 trained personnel and commanders was likely all lost. In contrast, Ukraine put no sailors at risk throughout the operation. The costs and physical risks for each side were completely disproportionate.[20]

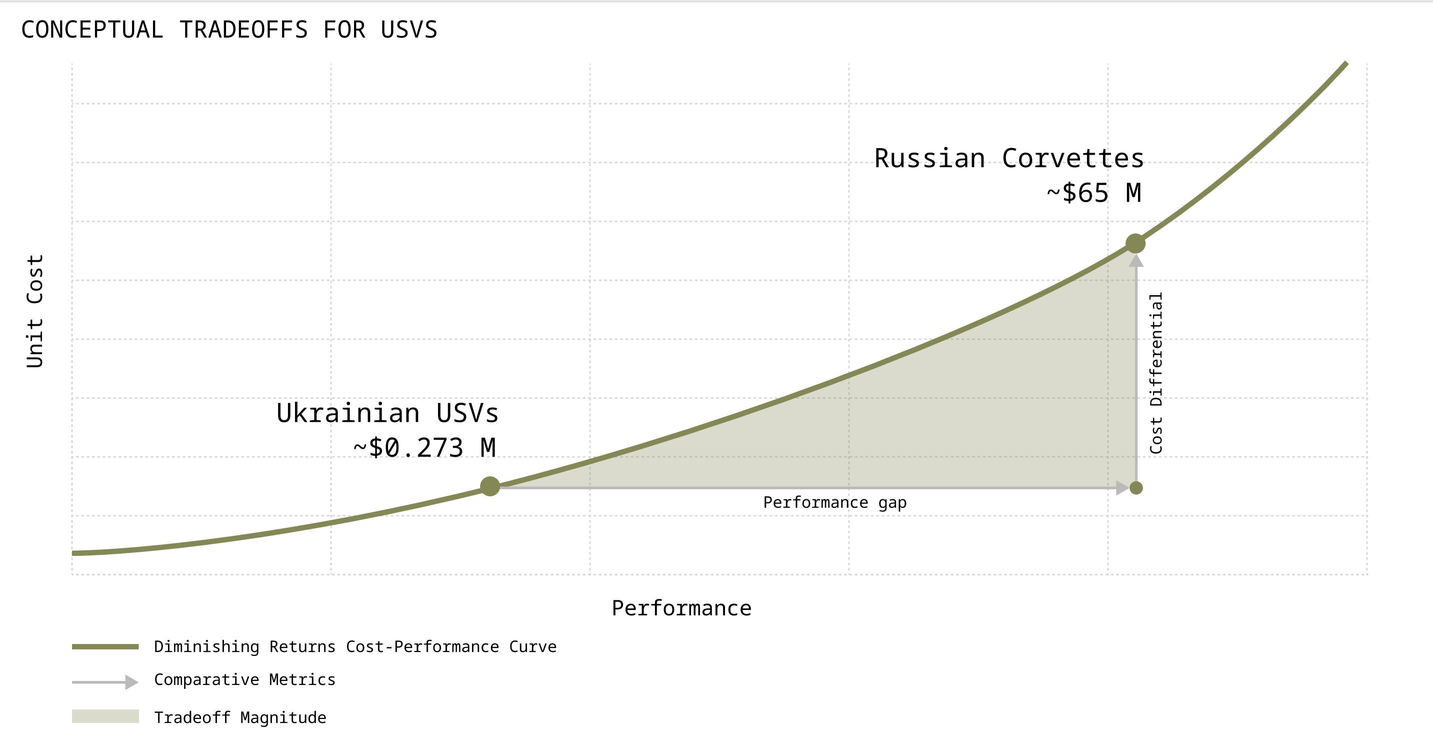


Figure 5. Generic tradeoffs of USVs in relation to cost against performance.
Note that performance is used illustratively to reveal aggregate capability dynamics. In practice, cheaper systems can still be more performant in very specific domains and vice versa.

Given the immense scale of the Chinese economy and its industrial base, any attempt to match their defense budget and material by Taiwan appears futile. However, expensive ships can be threatened by far cheaper systems like USVs.

This asymmetric approach aligns with Taiwanese strategic ends by inflating the costs of a potential invasion for Beijing, while significantly reducing them for Taiwan's defense.

19. Snake Island Institute, The Black Sea's Asymmetric Blueprint: Operational Lessons from Ukraine for 21st-Century Naval Forces (October 10, 2025), PDF, snakeisland.org
20. Snake Island Institute, The Black Sea's Asymmetric Blueprint

Rapid Adaptation Under Contestation

Unmanned systems provided Ukraine with a low-cost, low-stakes method of trial-and-error and adaptation. Operations that would be considered failures within a conventional naval framework, given the risk for loss of human lives, instead functioned as live experiments, exposing weaknesses in communications, control, and strike approaches. Losses became inputs into rapid iteration rather than cause for restraint.

The evolution of unmanned surface vehicles in Ukraine, as a result of these experiences, are testament to this rapid and continuous adaptation of doctrine, design, and innovation.

Evolution of MAGURA USV

The MAGURA drone program launched in May 2022, when SBU (Security Service of Ukraine) engineers converted a fishing boat into a remotely piloted vehicle using a Starlink terminal (V1). Within months, they introduced a second version with jet-ski propulsion (V2).[21] By fall 2022, the faster V3, capable of 80 km/h, carrying about 150 kg of explosives, and with an 800 km range, was ready for combat. Its first deployment failed after Starlink connectivity was lost; none of the drones reached the target, and only two of five returned. Later versions thus integrated redundant communication methods, such as a backup Kymeta satellite antenna.[22] On October 29, 2022, seven V3 drones conducted the first successful naval drone strike inside Sevastopol harbor, prompting Russia to invest in layered harbor defenses, including boom barriers and anti-torpedo nets.[23]

After a contractual split between the SBU and its private partners, GUR (Defense Intelligence of Ukraine) took over development and deployed the V5 by early 2023. The V5 featured a 5.5-meter carbon fiber hull, low radar visibility, an 800 km range, and a 200–320 kg warhead.

The first V5 missions failed: on May 24, 2023, three drones attacked the reconnaissance ship Ivan Khurs northeast of the Bosphorus, but two drones were destroyed and a third detonated near the hull without causing critical damage. A second attack on the Priazovye on June 11 also failed. Subsequent MAGURA operations adapted, shifting to nighttime group attacks involving five or more drones. Over time, this adjustment contributed to the successful strikes that sank Ivanovets, Caesar Kunikov, and Sergey Kotov.[24]

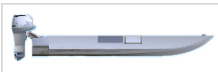
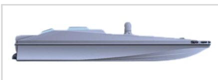
21. H. I. Sutton, "Overview Of Ukrainian Maritime Drones (USVs) Of The Russo-Ukrainian War," Covert Shores, September 30, 2025, hisutton.com
22. Snake Island Institute, The Black Sea's Asymmetric Blueprint
Defense Express, "All Upgrades to Ukraine's Sea Baby Naval Drone Analyzed: From Boat-Bomb to UAV Mothership With a Smart Turret and Mines," Defense Express, June 15, 2025, en.defence-ua.com
23. Snake Island Institute, The Black Sea's Asymmetric Blueprint.
24. Russia: Warship guarding Black Sea pipelines attacked by unmanned Ukraine craft," Reuters, May 24, 2023, reuters.com.
"Russia says Ukraine tried to attack Russian ship near major gas pipelines in Black Sea," Reuters, June 11, 2023, reuters.com.
Tom Balmforth and Yuliia Dysa, "Ukraine attacks Russian warships in Black Sea, destroys air defences in Crimea," Reuters, September 14, 2023, reuters.com.
Defense of Ukraine [@DefenceU] (Ministry of Defense of Ukraine), "Ship wreck of the day! Warriors of the special unit 'Group 13' of the @DI_Ukraine destroyed the missile corvette 'Ivanovets' of the russian Black Sea Fleet. As a result of a number of direct hits to the hull, the corvette was damaged, rolled to the stern, and sank. The value of the ship is approximately $60–70 million. Nice job, warriors!", X post, February 1, 2024, x.com.
Defense of Ukraine [@DefenceU] (Ministry of Defense of Ukraine), "Veni, vidi, vici. @DI_Ukraine released video of the successful strike on the Russian landing ship Caesar Kunikov.", X post, February 14, 2024, x.com.
Snake Island Institute, The Black Sea's Asymmetric Blueprint.

By late 2023 and into 2024, Ka-27 and Mi-8 helicopters with thermal imagers became Russia's most effective counter, systematically hunting USVs at sea. Ukraine's answer was the V5 retrofitted with an improved "Sea Dragon" air defense system, consisting of two R-73 infrared-homing missiles on angled rails, with a widened seeker envelope. On December 31, 2024, R-73-armed drones downed two Mi-8s and damaged a third near Cape Tarkhankut, marking the first aerial kills by unmanned surface vessels in history.[25]

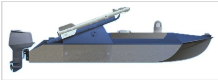
On May 2, 2025 the larger MAGURA V7, now armed with AIM-9 Sidewinder missiles, destroyed two reconnaissance Su-30SMs, about 50 km west of Novorossiysk, becoming the first jet kill by a naval drone.[26] Each major Russian adaptation was met by a Ukrainian counter-innovation in less than a year, at a fraction of the cost, rendering previous Russian investments obsolete.

Table 1. MAGURA USV: adaptation timeline (2022-2025).

Operator: GUR. Base platform: 5.5 - 7.2 m carbon fiber hull, 42 kn, 800 km range, 250–320 kg warhead, ~$273,000.

DATE	MODEL	DETAILS	KEY OPERATIONS	SIGNIFICANCE
May 2022	V1 	Prototype made from a fishing boat and equipped with a Starlink terminal.	—	Proof of concept for remote maritime strike.
Spring-summer 2022	V2 	Improved version of V1 with jet-ski drive and an internal motor.	—	Laid ground to the combat-proven MAGURA V3.
Fall 2022	V3 	Speed: 80 km/h Range: ~800 km Payload: ~150 kg	Sevastopol strike (October 29, 2022; successful)	First successful use of naval drones that damaged Admiral Makarov frigate and Ivan Golubets minesweeper.
2023	V5 	Length: 5.5 m Range: ~830 km Payload: ~320 kg	• Attack on Ivan Khurs reconnaissance ship (May 24, 2023; unsuccessful) • Attack on Priazovye reconnaissance ship (June 11, 2023; unsuccessful) • Attacks on Sergey Kotov ship (September 14, 2023; successful) • Attacks on Ivanovets corvette; Caesar Kunikov landing ship (February 1, 2024; February 14, 2024; successful)	Failed attacks prompted Ukraine to move from daytime and small-group attacks to nighttime swarms, which proved to be effective.

25. Valentyna Romanenko, "Double kill: Ukrainian intelligence confirms that its drones destroyed 2 Russian helicopters in Crimea on 31 December," Ukrainska Pravda, January 2, 2025, pravda.com.ua
26. GUR, "World First: Defence Intelligence of Ukraine Destroys russian Su-30 Fighter Jet with a Sea Drone Strike", May 3, 2025, gur.gov.ua.
27. Sutton, "Overview Of Ukrainian Maritime Drones (USVs) Of The Russo-Ukrainian War."
Snake Island Institute, The Black Sea's Asymmetric Blueprint.

DATE	MODEL	DETAILS	KEY OPERATIONS	SIGNIFICANCE
May 2024	W6 with AA-11(R-73) missiles 	Features an improvised "Sea Dragon" air defense system carrying AA-11(or Soviet-made R-73) missiles.	Attack on two Mi-8 helicopters (December 31, 2024; successful)	First helicopter downed by a naval drone.
May 2025	V7 with AIM-9 Sidewinder missiles 	Features an improvised "Sea Dragon" air defense system carrying AIM-9 missiles.	Attack on two Su-30 near Novorossiysk (May 2, 2025; successful)	First jet killed by a naval drone. Russia was forced to abandon low-altitude aviation over contested Black Sea zones.

Sources: H. I. Sutton, Snake Island Institute.[27]

Evolution of Sea Baby USV

The Sea Baby platform followed a parallel trajectory toward becoming a multi-purpose unmanned combatant through iterative updates. Developed by the SBU and manufacturing partner after the initial operational experience with early MAGURA systems, Sea Baby entered combat on July 17, 2023, when it struck the Kerch Bridge, damaging one of its spans. Compared to early MAGURA variants, Sea Baby was designed for longer-range operations and carried a substantially larger payload, reportedly up to 860 kg.

In mid-2023, another Sea Baby variant known as Mamai, carrying roughly 450 kg of explosives, was employed in the strike on the landing ship Olenegorsky Gornyak at Novorossiysk. In August 2023, this variant was publicly presented, with officials emphasizing its prioritization of speed (up to approximately 110 km/h) and survivability at the cost of reduced payload. By September, a mine-laying version damaged the corvette Samum, showing that Sea Baby could also block or threaten key areas at sea, not just hit targets directly.

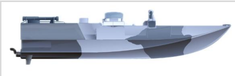
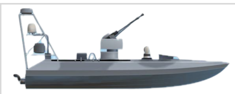
In March 2024, Ukrainian officials publicly unveiled an upgraded Sea Baby configuration capable of carrying guided missile launchers, laser designators, thermobaric weapons, and serving as a carrier for smaller drones. In May 2024, testing footage showed the platform equipped with unguided rocket artillery launchers for shore strikes.[28] By December 2024, video evidence indicated that Sea Baby variants fitted with machine-gun turrets were engaging Mi-8 helicopters and small patrol craft, suggesting an expanded role that included active counter-air and close-range defense functions.[29]

Early 2025 brought new Sea Baby models that could carry and launch fiber-optic drones, making them harder to stop with electronic jamming and able to attack from both the air and sea.[30] That October, a new generation of Sea Baby was introduced, combining these features: longer range, larger payload, smarter targeting, and the ability to return safely to base.[31] In December, Sea Baby went underwater for the first time, with a "Sub Sea Baby" reportedly hitting a Russian Varshavyanka (Kilo)-class submarine, thus marking a new chapter in naval warfare.[32]

28. Zakharchenko, Kateryna. "SBU Uses Sea Baby USV Armed with Grad Rocket Launchers to Attack Russians on Land." Kyiv Post, May 22, 2024. kyivpost.com
29. Defense Express. "Морські дрони Sea Baby тепер з кулеметами і самі полюють на російські вертольоти та катери (відео) [Sea Baby naval drones now with machine guns and hunting Russian helicopters and boats (video)]." December 9, 2024. defence-ua.com
30. Defense Express. "Українські морські дрони вперше помічено з FPV-дронами на оптоволокні, і це про складніші удари для ворога [Ukrainian naval drones first observed with fiber-optic FPV drones, indicating more complex strikes for the enemy]." September 27, 2025. defence-ua.com
31. Security Service of Ukraine. "СБУ продемонструвала нове покоління легендарних морських дронів «Sea Baby» (відео) [The SBU showcased a new generation of the legendary sea drones 'Sea Baby' (video)]." October 22, 2025. ssu.gov.ua
32. Frederik Van Lokeren, "Ukraine strikes Russian submarine with 'Sub Sea Baby' drone," Naval News, December 16, 2025, navalnews.com.

Table 2. Sea Baby USV: adaptation timeline (2022-2025).

Operator: SBU. Base platform: 6m hull, twin 200 hp waterjets, 49 kn, up to 1,000 km range, up to 850 kg payload, ~$240,000.

DATE	MODEL	DETAILS	KEY OPERATIONS	SIGNIFICANCE
July 2023	Baseline 	Payload: 850 kg Speed: 90 km/h Range: up to 1 000 km	Struck the Kerch Bridge (July 17, 2023; successful)	First successful use of USV against the Kerch bridge and surrounding infrastructure.
August 2023	Mamai USV 	Payload: 450 kg Speed: 110 km/h	Strike on landing ship Olenegorsky Gornyak, Novorossiysk (August 4, 2023; successful)	Successfully engaged large vessels and port infrastructure with smaller size and larger speed.
May 2024	Sea Baby with MLRS “Grad” 	Modular combat configuration capable of carrying 10-round Grad-type MLRS; adaptable weapons architecture	Strikes against Russian positions on the Kinburn Spit (May 22, 2024; successful)	Transformed Sea Baby from expendable kamikaze into a reusable combatant with active self-defense, enabling them to engage with other targets.
December 2024	Sea Baby II with machine gun 	Fitted with gyrostabilized machine-gun turret for close defense	Engagements against Mi-8 helicopters and Raptor-class patrol boats (December 2024; successful)	Transformed Sea Baby from expendable kamikaze into a reusable combatant with active self-defense, enabling them to engage with other targets.
Early 2025	Sea Baby with FPV drone carrier 	Equipped to launch fiber-optic FPV drones resistant to electronic warfare	Attacks on the ports of Tuapse and Novorossiysk (September 24, 2025; successful)	Made the platform immune to jamming and electronic warfare; terminal strikes conducted by launched FPVs rather than the mothership itself, enabling platform reuse across multiple sorties.
December 2025	Sub Sea Baby 	UUV	Struck a Russian Project 636.3 Varshavyanka (Kilo)-class submarine (December 15, 2025; successful)	First known attack on a submarine by an unmanned underwater vehicle, which extended the maritime drone threat beneath the surface.

Source: H.I. Sutton, Snake Island Institute.[33]

33. Sutton, “Overview Of Ukrainian Maritime Drones (USVs) Of The Russo-Ukrainian War.”

From this record, several conclusions emerge:

- There is roughly a one-year interval between initial testing and formal public demonstration
- Approximately every six months, a new version of a drone appears in combat reports, typically with modified payload or capabilities
- Losses function as live experiments, allowing for rapid iteration without human cost
- Early failures in communication drove the integration of backup satellite antennas and alternative comms systems
- USVs expanded from expendable strike weapons to multi-role combatants
- Ukraine consistently countered each major Russian adaptation within less than a year, at a fraction of the cost, rendering Russian defensive investments obsolete

By fostering horizontal links between state defense agencies and private tech developers, Ukraine bypassed traditional, multi-year procurement cycles. In the absence of such adaptations, even numerically large inventories lose relevance as adversaries adapt. Ukraine's experience indicates that operational adaptability became the decisive advantage, outweighing the performance of any individual configuration.

The window for a potential amphibious invasion in Taiwan is likely far shorter than the six-month to one-year cycles observed in Ukraine, especially given the scale necessary to repel a Chinese invasion of Taiwan. Supply chain disruptions and the difficulty of producing new platforms during a campaign further limit the opportunity for in-theater adaptation. Under these conditions, one potential approach is to diversify platforms prior to deployment. Maintaining a range of drones with different payloads, ranges, speeds, and integration options could help reduce reliance on any single system, and allow forces to employ multiple attack or reconnaissance options simultaneously.

At the same time, Taiwan should institutionalize local R&D ecosystems capable of rapid, incremental hardware and software updates. Close coordination between government agencies and private developers on the island may facilitate such rapid adjustments and ensure that lessons learned in practice can be incorporated efficiently. Attention should also be focused on persistent vulnerabilities, such as communication links. Incorporating redundant command-and-control pathways, autonomous navigation, and preprogrammed mission profiles may help maintain operational effectiveness even if satellite and RF links are degraded. By combining platform diversity with targeted R&D and planning for critical limitations, Taiwan could enhance operational flexibility and resilience.

Chapter 3. Adapting Ukrainian Lessons to the Taiwan Strait

In discussing lessons from Ukraine for Taiwan, we must consider the difference in environmental conditions and how they affect the performances and expectations of USV employment. The Taiwan Strait is a far harsher operating environment than the Black Sea: wave heights are higher for much of the year, seasonal monsoon winds and strong currents are persistent, and weather windows are less forgiving. These factors are often cited as evidence that maritime drones effective in the Black Sea would be far less useful in the strait.

But the interplay of tidal ranges, strong currents, and restrictive underwater topography also influences the movement of Chinese forces, constrains feasible approach corridors, determines potential zones for mine deployment, and channels amphibious operations in predictable ways, all of which, in turn, affects how and where unmanned surface vehicles can be employed.

Close analysis of this question reveals that geography and environmental conditions act as a double-edged sword.

Rather than treating environmental conditions as fixed constraints, the section frames them as factors that must be incorporated into how Taiwan plans, designs, and employs USVs.

Amphibious Operation-Relevant Environmental Factors

The success of an amphibious operation depends not just on the initial landing, but on keeping the entire logistical cycle running smoothly. Forces must leave their ports, cross the Strait, land in organized waves, unload, and return for the next sortie. How quickly troops and equipment can build up ashore depends on how well these steps are coordinated and repeated.

At its narrowest point, the Taiwan Strait is about 130–180 kilometers wide, with an average depth of around 60 meters. Any landing would most likely start from China's Fujian Province, due to its geographic proximity and the PLA's regular exercises in the area. From there, ships must cross open water before reaching Taiwan's western coast.

The landing itself is tightly shaped by geography. Forces cannot approach from just any direction or land anywhere along the shoreline. Water depth, the shape of the coast, tides, currents, and available ports all determine where and when ships can operate. While vessels have some room to maneuver in the middle of the Strait, that freedom shrinks quickly in the final 20–30 kilometers before the shore.[34,35]

34. PBS NewsHour, "China holds live-fire military drills opposite Taiwan, a week after large-scale exercise," October 22, 2024, pbs.org
35. Simone McCarthy et al., "China announces war games around Taiwan after hitting out at major US arms deal," CNN, December 28, 2025, cnn.com
Eric Heginbotham et al., The U.S.–China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017 (Santa Monica, CA: RAND Corporation, 2015), rand.org

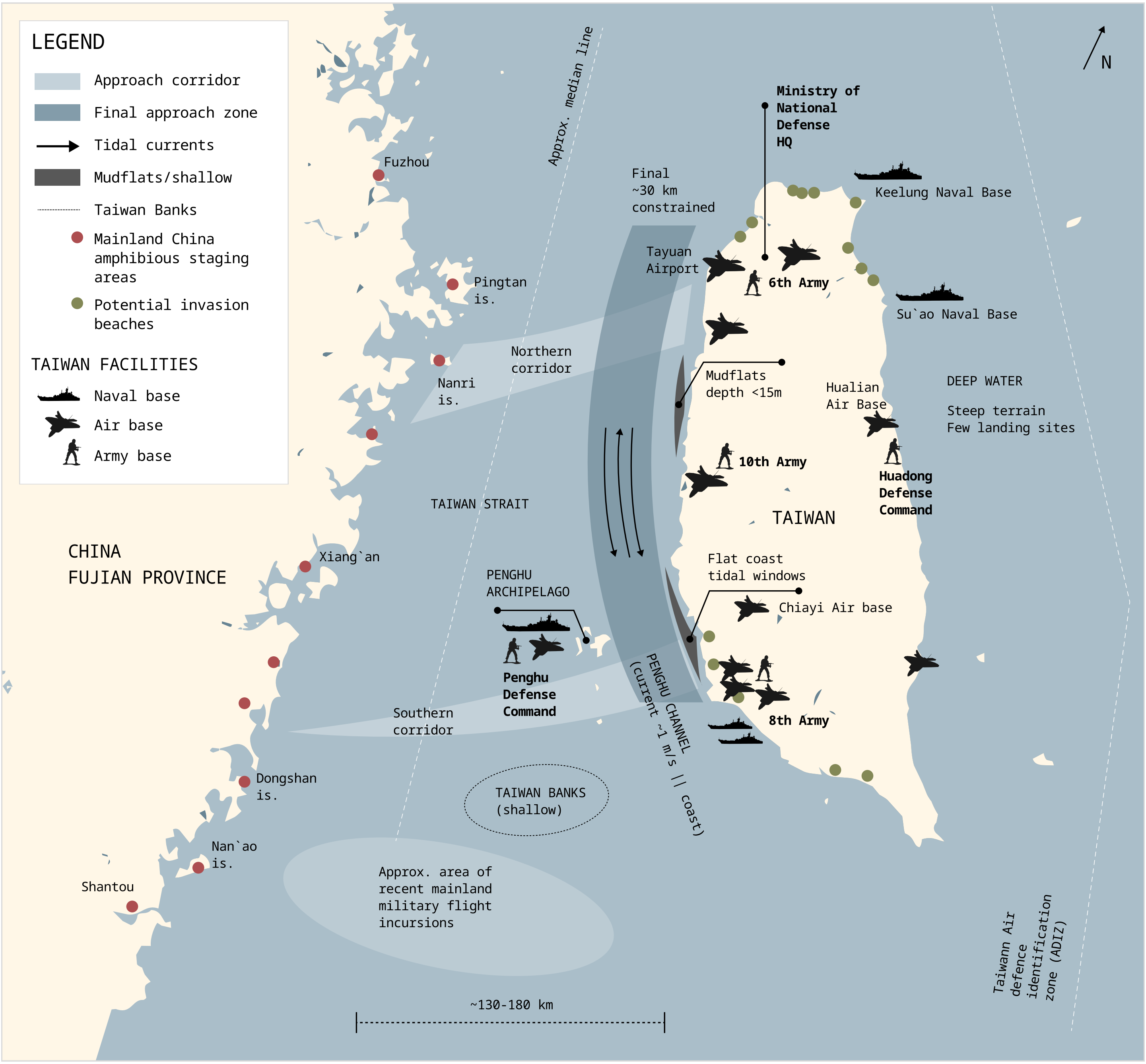


Figure 6. Environmental constraints and approaches from China's Fujian Province to Taiwan's Western shore. AFP. Military facilities and strategic security locations in Taiwan.[36]

Taiwan's western coastline appears accessible due to its flat terrain and broad beaches, but bathymetry sharply limits maneuver freedom during final approach.

- Mudflats can extend up to 200 meters offshore during ebb tides
- Nearshore depth in many areas falls below 15 meters within the final 20 kilometers of approach
- Twice-daily tides produce vertical water-level changes of up to approximately two meters

For amphibious forces, these conditions constrain viable landing windows into specific tidal phases. Landing craft must approach during periods of sufficient water depth to avoid involuntary grounding. Yet the landing must remain synchronized with the larger operational plan. Delays outside optimal tidal windows risk desynchronizing follow-on landings and disrupting formation coherence. Disrupting this synchronization might make a landing increasingly difficult and hold off Chinese forces from consolidating on Taiwan's shores.

36. AFP News Agency [@AFP], "Sizing up Taiwan. #AFPGraphics on military facilities and strategic security locations in Taiwan, plus mainland China's amphibious staging areas on the other side of the Taiwan Strait," X post, August 4, 2022, x.com

Outside deepened channels, most notably the Penghu Channel and major port approaches, involuntary grounding risk increases significantly. The Penghu Channel itself narrows maneuver space, functioning as a natural funnel between the Penghu Archipelago and Taiwan proper. Near the Taiwan Banks and within the Penghu Channel, peak tidal currents reach approximately 1m/s (roughly two knots) and often run parallel to the coast.

For a landing formation attempting to adhere to a precise schedule and location, currents of this magnitude present an obstacle. Continuous course corrections to counter the drift effect increase collision risk and formation compression, especially with reduced visibility or electronic disruption.[37] Additionally, these prolonged actions increase the chance of interdiction.

In practical terms, this means:

- Amphibious forces cannot freely disperse near shore without risking unintentional grounding
- Final approaches are functionally constrained to a limited number of predictable corridors
- Landing timing is tightly coupled to tidal cycles rather than tactical preference
- Evasive maneuver during final approach is severely limited by water depth and the need to adhere to a tight operational plan

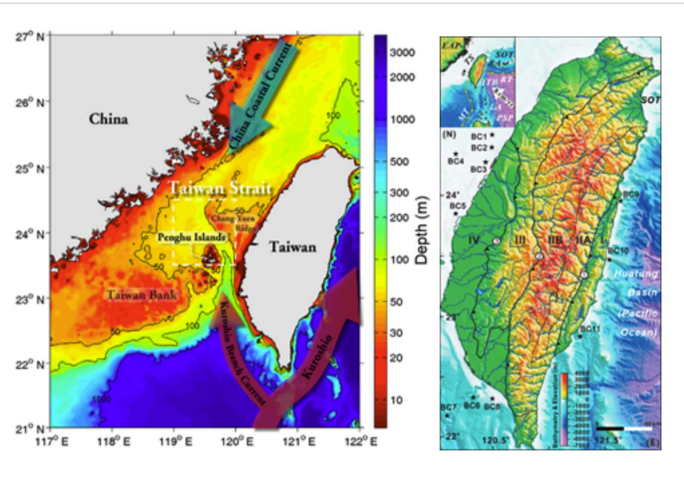


Figure 7. Left: Continental Shelf Research. Bathymetric chart of the coastal currents around the Taiwan Strait.[38] Right: Geochemistry, Geophysics, Geosystems. Topographic Map of Taiwan.[39]

Taiwan's eastern coast presents a different constraint profile. Deep waters close to shore allow large vessels to operate nearer to land with minimal grounding risk. From a purely maritime perspective, this provides greater offshore maneuver space.

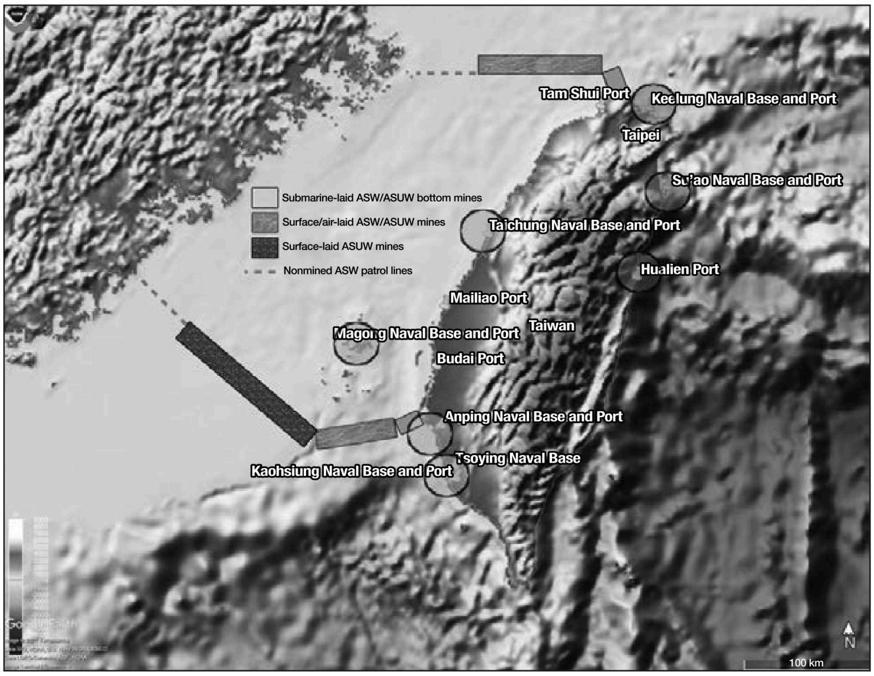
However, the steep terrain and mountainous topography in that region sharply limit viable landing areas. Access points are concentrated around a small number of ports and developed infrastructure nodes. Amphibious movement along the eastern coast would thus be predictably channeled toward these few access points Taiwan would have little difficulty anticipating Chinese fleet movements in this scenario, and could maximise attrition accordingly.

Given different levels of depth and seabed structure, mine placement is another option for Taiwan. Offensive mine deployment would likely concentrate along western approach corridors, near strait entrances, and around the major ports; whereas defensive mine employment would likely focus on western invasion beaches, approaches near Kinmen Island, and territorial waters along the most probable landing corridors.[41] In combination with shallow waters, tidal timings, and dredged channels, these mine zones reinforce corridor compression, thus reducing the PLAN's maneuver freedom to a limited number of predictable routes and time windows.

In maritime and amphibious operations, weather and seasonal conditions constitute one of the key constraining factors that cannot be adapted to in real time. They define the very feasibility of an operation, its temporal windows, and the range of assets that can be employed. Among the most critical variables for maritime operations are sea state, wind, cloud cover, and fog, as these factors directly affect navigation, command and control, the employment of naval and air assets, and the execution and support of amphibious landings.[42]

37. S. Jan et al., "Incremental Inference of Boundary Forcing for a Three-Dimensional Tidal Model: Tides in the Taiwan Strait," Continental Shelf Research 24, no. 3 (2004): 337–351, doi.org
38. Y.-H. Cheng and M.-H. Chang, "Exceptionally Cold Water Days in the Southern Taiwan Strait: Their Predictability and Relation to La Niña," Natural Hazards and Earth System Sciences 18, no. 7 (2018): 1999–2010, doi.org
39. Horng, C.-S., Huh, C.-A., Chen, K.-H., Lin, C.-H., Shea, K.-S., & Hsiung, K.-H. (2012). Topographic map of Taiwan and bathymetry of the surrounding seafloor (Figure 1) [Image]. In Pyrrhotite as a tracer for denudation of the Taiwan orogen. Geochemistry, Geophysics, Geosystems, 13, Q08Z47. Topographic map of Taiwan and bathymetry of the surrounding seafloor.... | Download Scientific Diagram

Exhibit 1. Bathymetry and Notional PRC Minefields in Vicinity of Taiwan



Notes: ASUW = antisurface warfare; ASW = antisubmarine warfare.

Figure 8. Bathymetry and notional PRC minefields.[40]

Weather conditions in the Taiwan Strait also tend to disrupt whole amphibious operations more than they limit any single platform. The conditions we consider "limiting" for drones are costly for amphibious coordination.

Delays in amphibious landings make it less likely for the PLA forces to consolidate along Taiwan's beaches and ports in sufficient numbers and in due time for a successful operation. A simple example is the relationship between amphibious assault ships and their landing craft:

- Large-deck amphibious assault ships (LHDs), such as the PLAN's Type 075, are generally assessed as capable of flight and well-deck operations up to Sea State 4 (Significant Wave Height of roughly 1.25–2.5 m)[43]
- Air-cushion landing craft (LCACs), which are central to over-the-horizon assault concepts, are typically limited to Sea State 2–3 (approximately 0.5–1.25 m)[44]

As sea state approaches the LCAC capability limit, launch and recovery must be delayed or suspended, even if the host ship and aviation components remain operable. Because helicopter assaults, surface waves, and naval fires are sequenced around a common H-hour, the loss of one element removes entire assault phases.

These differences are reinforced by human factors: rough seas and strong winds increase deck motion and crew fatigue. As a result, commanders often suspend operations for safety reasons before platform technical limits are formally reached.[45] USVs lack this human vulnerability. While they may face range degradation due to currents, they do not suffer from fatigue, nor do they require the high-risk "launch and recovery" synchronization that paralyzes manned fleets in marginal weather.

40. Andrew S. Erickson, Conor M. Kennedy, and Ryan D. Martinson, eds., Study No. 8, Chinese Amphibious Warfare: Prospects for a Cross-Strait Invasion (Newport, RI: China Maritime Studies Institute, U.S. Naval War College; Naval Institute Press, 2024), 224, digital-commons.usnwc.edu
41. Yasuhiro Kawakami, "Mine Warfare in a Taiwan Contingency - Scenarios for Naval Mine Use and Its Impact on Japan," International Information Network Analysis, The Sasakawa Peace Foundation, February 25, 2022, spf.org
42. Matteo Zanotti, "The Impact of Weather Conditions on Amphibious Military Operations," Finabel, November 30, 2022, finabel.org
43. Australian National Audit Office, "LHD Ships: Project Data Summary Sheet," in 2014–15 Major Projects Report (ANAO Report No. 16 2015–16, 2016), PDF, anao.gov.au
44. Textron Systems Marine & Land Systems, Landing Craft, Air Cushion (LCAC) Specifications, brochure (2015), PDF, textronsystems.com
45. Zanotti, "Impact of Weather Conditions"

Similarly, frequent fog in the Taiwan Strait creates a clear tactical advantage for USVs. Low visibility halts the coordination and command of large amphibious fleets, but allows small, low-profile systems to operate covertly. Fog degrades enemy surveillance, shortening reaction times. Manned vessels must slow down and increase watch-keeping, while USVs can maneuver at speed and exploit these visibility gaps.[46]

Ultimately, environmental constraints such as coastal geometry, bathymetry, tidal cycles, and weather collectively limit the PLA's options. The net effect is structural predictability. The Taiwan Strait imposes an exposed transit phase, tidal-dependent landing windows, channelized final approaches, and limited dispersion options near shore, allowing for Taiwan to prepare along these approaches.

USV-Relevant Environmental Factors

For unmanned surface vehicles, environmental conditions set the basic limits of use. Wave height affects hull stability and speed; wind strength and direction influence energy consumption and course-keeping; visibility conditions shape navigation safety and the reliability of remote control. Together, these factors determine when and where USVs can operate and feed directly into design choices related to hull form, propulsion, onboard energy reserves, and the robustness of command-and-control links.

The clearest indicator of USV operational viability is sea state, as measured by significant wave height (SWH).[47] SWH, which measures the average wave height of the highest third of waves, is a widely used metric to determine small vessel viability. The U.S. National Weather Service often issues a small craft advisory when wave heights exceed 2–2.5 meters, and the risk of capsizing increases quickly after this mark.[48] Consistent with these estimations, the Security Service of Ukraine (SBU) has reported that its Sea Baby USV has successfully struck Russian vessels in wave heights of 1.5–2 meters.[49]

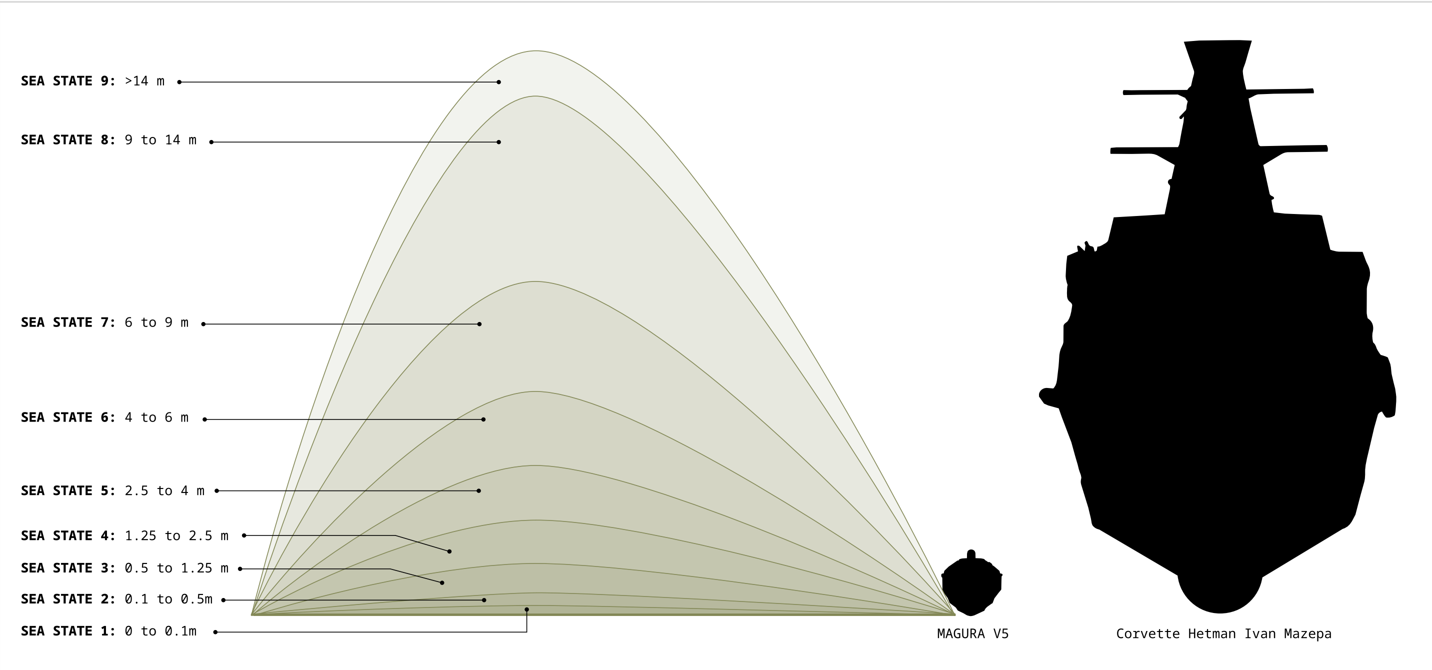


Figure 9. Illustration of wave height by categories of sea-state.[50]

46. Erickson, Kennedy, and Martinson, Chinese Amphibious Warfare
47. Emerson Martins de Andrade, Joel Sena Sales Jr., and Antonio Carlos Fernandes, "Operative Unmanned Surface Vessels (USVs): A Review of Market-Ready Solutions," Automation 6, no. 2 (2025): 17, doi.org
48. National Weather Service, "Coastal Warning Display Program," National Oceanic and Atmospheric Administration, accessed February 28, 2026, weather.gov
49. Front_Ukrainian [@front_ukrainian], "Some Ukrainian media, citing their sources, report that yesterday an experimental 'Sea Baby' (marine drone) of the Security Service of Ukraine damaged the Russian missile boat 'Samum' in the Black Sea," X post, September 15, 2023, x.com
50. Government Accountability Office. (2016). National Security Cutter: Enhanced Oversight Needed to Ensure Problems Discovered during Testing and Operations Are Addressed. GAO-16-148. gao.gov

To verify these claims, SII has geolocated a collection of successful Ukrainian USV strikes and, using Copernicus Maritime Service's database of Black Sea wave conditions, estimated the SWH during each of the strikes.[51] The results generally validated the SBU's claims, though more direct analysis of Ukrainian USV operability is warranted. According to SII analysis, most successful USV operations occurred in conditions with a maximum SWH (VHM0) below 1 meter. Some successful operations in conditions exceeding that height, up to 1.61 meters, were also recorded. However, these figures represent only the highest average height of the highest third of all waves, not the highest single wave recorded. As such, the Ukrainian USVs likely encountered individual waves higher than 1.61 meters.

TARGETED VESSEL TYPE	TARGETED SHIP CLASS (PROJECT N°)	ESTIMATED SIGNIFICANT WAVE HEIGHT
Large Landing Ship	Ropucha (Project 775)	0.78
Missile Corvette	Dergach/Bora (Project 1239)	0.8
Patrol Ship	(Project 22160)	1.04
Patrol Ship	(Project 22160)	0.82
Missile Corvette	Buyan-M (Project 21631)	0.82
Landing Craft	Serna (Project 11770)	1.33
Landing Craft	Ondatra (Project 1176)	1.33
Missile Corvette	Tarantul (Project 1241)	0.17
Large Landing Ship	Ropucha (Project 775)	1.61
Patrol Ship	(Project 22160)	0.63

Table 3. Wave Conditions During Successful Ukrainian USV Strikes

While small wave heights make the Black Sea relatively conducive to small-craft operations, Taiwan's higher waves make it a more complex environment for USVs.[52] A simulation of wave heights from 1988 to 2017, validated against measured data, indicates that mean significant wave heights generally remain below 2 m, fluctuating from around 1 m in September to peaks of 2.8 m during the January monsoon. These figures also vary geographically, with the island's southwest coast offering the most stable conditions.[53]

Winter wave heights frequently exceed the 2 m threshold typical for Ukrainian-sized USVs (5–7 m), pushing smaller platforms toward their performance limits. This suggests that Taiwanese USV designs may benefit from slightly larger or more robust hulls to ensure operational availability year-round. Conversely, extremely calm conditions (SWH below ~0.5 m) are disadvantageous for low-profile craft, as minimal surface clutter increases visual and radar detectability. On a mirror-like surface, a USV's wake creates a high-contrast trail that can be spotted by high-altitude surveillance from dozens of kilometers away. Despite a relatively small radar cross-section, the drone's hull stands out sharply against the flat horizon. Moderately high waves, roughly 1–1.6 m, therefore, offer an ideal balance, enabling reliable operation while providing natural concealment.

Figure 10. Australian USV "Sea Archer" with long visible trail[54]

51. Staneva, Martin Ricker, and Anke Behrens, Black Sea Waves Analysis and Forecast (CMEMS BS-Waves, EAS5 System) (Version 1), data set, Copernicus Marine Environment Monitoring Service (CMEMS), 2022, doi.org
52. Salvatore Causio et al., "The Black Sea Near-Past Wave Climate and Its Variability: A Hindcast Study," Frontiers in Marine Science 11 (2024): 1406855, doi.org
53. S. Dong, Yijie Gong, and Zhifeng Wang, "Long-Term Variations of Wind and Wave Conditions in the Taiwan Strait," Regional Studies in Marine Science 36 (2020): 101256, doi.org
54. Xavier Vavasseur, "Leidos Proceeds with Sea Archer USV Trials in Australia," Naval News, April 2026, Leidos proceeds with Sea Archer USV trials in Australia - Naval News

Strong and unpredictable currents along the western Taiwan Banks and the Penghu Channel add energy demands for station-keeping and course correction, potentially reducing endurance. However, the Strait's relatively narrow geography, compared with the hundreds of kilometers typical for the Black Sea, largely mitigates these constraints.

Taken together, these factors indicate that while the Strait imposes higher sea-keeping demands, its combination of moderate wave states, tidal currents, and restricted geography creates an environment that favors concealment.

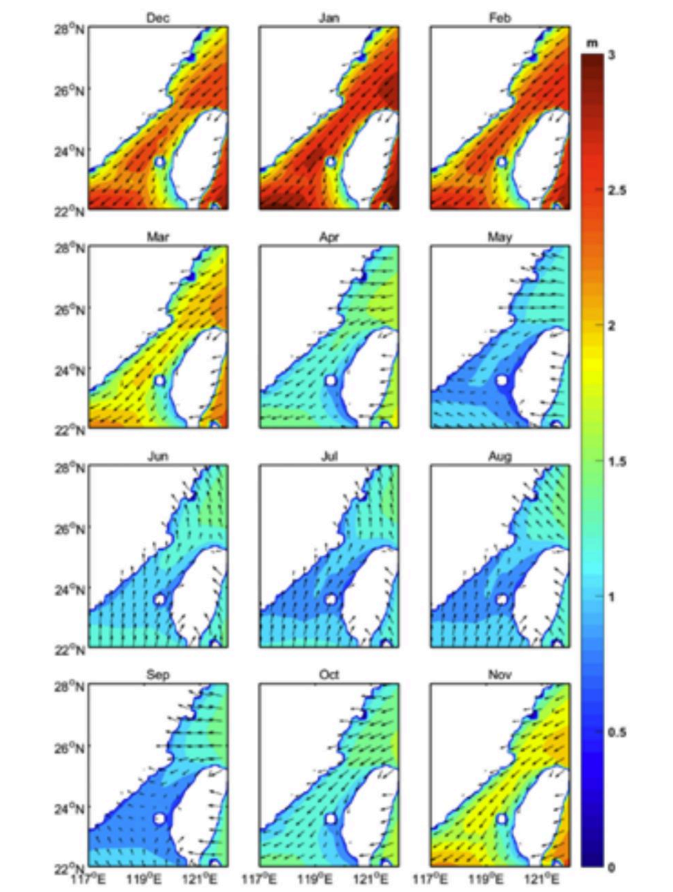


Fig. 10. Spatial distribution of the monthly significant wave height and wave direction.

Figure 11. Regional Studies in Marine Science. Spatial distribution of the monthly significant wave height and wave direction.[55]

Impact on USVs

Consequently, the operational impact of sea state on USVs is most pronounced offshore, while currents and coastal flows dominate nearshore planning. These environmental factors influence the design, endurance, and routing of unmanned systems without diminishing their core tactical value. In many scenarios, challenging conditions create an advantage: high sea states and persistent fog provide natural concealment for maneuvering, even as the same conditions paralyze or suspend crewed amphibious operations. Environmental limits define the engineering and operational boundaries for USVs, yet within these bounds, they retain flexibility and surprise that traditional manned systems cannot match.

Unlike the Black Sea, the Taiwan Strait is relatively narrow, with cross-strait transits of only a few hours. Shorter distances reduce the range and endurance demands on USVs, but also compress the time available to detect targets, maneuver into position, and execute strikes. To operate effectively, USVs should be pre-positioned near likely transit corridors, focus on high-value targets, and synchronize their movements with the timing of amphibious forces and tidal windows.

Once a landing window or approach corridor is identified, unmanned systems can be tasked for persistent monitoring, cueing, and targeting. Corridor compression also limits the ability of amphibious forces to laterally adjust in response to detection, increasing the effectiveness of surveillance, strike, electronic warfare, and mine-based interdiction systems.

To remain effective, Taiwanese USV tactics should exploit rather than resist the environmental constraints imposed by the Strait. Even relatively low-cost unmanned systems can exert outsized influence by exploiting geography-driven constraints rather than attempting to overcome them.

55. Dong, Gong, and Wang, "Long-Term Variations of Wind and Wave Conditions"

Chapter 4. Taiwan's USV Design Philosophy

As a result of the constraints unique to Taiwan's waters and strategic objectives, key tradeoffs were made in the design choices of Taiwanese USV platforms with clear implications for their operational and tactical employment. Unlike Ukraine's use of USVs for sporadic attacks against key targets, Taiwan's USVs are designed to strengthen a layered defensive strategy. Yet varying degrees of tradeoffs observed in mobility, lethality, survivability, and sensory acuity which we examine in this section reveal a misalignment between system designs and current Taiwanese force structure and defense planning.

Key Platforms

Taiwan is currently developing two flagship USV platforms, namely the Kuai Chi and the Endeavor Manta. We compare them against the Ukrainian models of MAGURA V5 and Sea Baby drones who have been at the forefront of the Black Sea campaign.

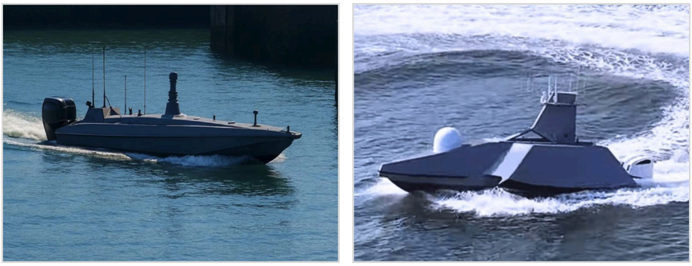


Figure 12. Left: Army Recognition. Taiwan's Kuai Chi uncrewed surface vessel.[56]
Right: MI News Network. Endeavor Manta.[57]

The Kuai Chi is a small monohull craft with twin outboard diesel motors. It incorporates a ram-charge in the bow, and can also field six launch tubes for Taiwan's indigenous Chin Feng I loitering munition. The Endeavor Manta is a multi-role system capable of ISR and kinetic strikes, armed with two light torpedoes mounted on either side of its trimaran hull.

Mobility

Taiwanese mobility preferences reflect the conditions of the strait, and suggest different operational use-cases than Ukraine. A look at the different technical specifications for these models reveal clear differences in the focus of their mobility, as measured by speed, range, acceleration, agility, trafficability, and displacement. Our analysis particularly focuses on the tradeoff between range, speed, and trafficability due to its relevance for the Taiwanese environment and the notable differences observed.

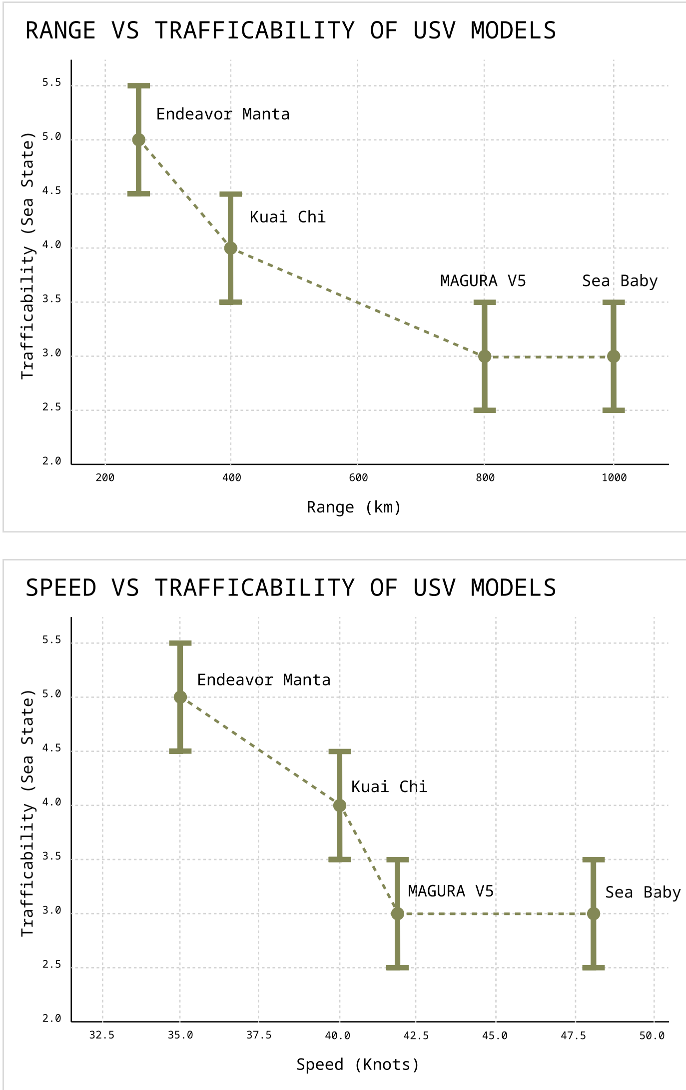


Figure 13. Mobility models for selected USVs.

56. Army Recognition, "Taiwan strengthens defense strategy with 1,320 Kaui-Chi naval drones to dissuade Chinese assault," August 25, 2025, www.armyrecognition.com
57. MI News Network, "Taiwan Unveils Its First Domestically Built Unmanned Ship, 'Endeavor Manta'," Marine Insight, March 26, 2025, www.marineinsight.com

Both the Endeavor Manta and the Kuai Chi sacrifice range and speed in favor of greater trafficability. In fact, the range gap between the Kuai Chi and its nearest Ukrainian peer is no less than 400 km. Likewise, neither Taiwanese models match nor exceed MAGURA V5 and Sea Baby top speeds. Unlike Ukrainian systems, which are clearly optimized for long-range strikes across the relatively expansive Black Sea, Taiwanese platforms therefore appear to be tailored for a significantly reduced theatre of operations.

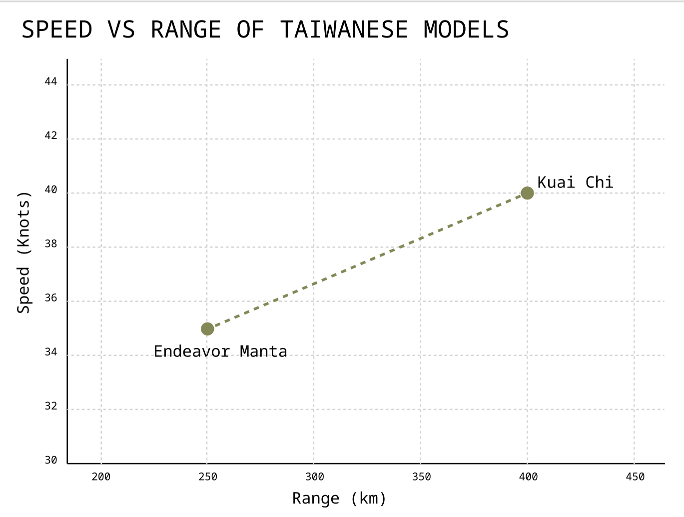


Figure 14. A comparison of range and speed between Taiwanese USV models.

Beyond adapting to the needs of the Strait, comparing Taiwanese USV designs against one another reveals different specialisations altogether. The Endeavor Manta accepts far lower range and speed than its less sophisticated counterpart, which allows it to maximise lethality and survivability, as explored below.

Other variations in design tradeoffs across Taiwanese models are made apparent in agility. We measure agility through the length-to-beam (L/B) ratio. Lower L/B ratios reflect shorter and wider platforms and are usually a good indicator of rapid turning ability. But wider beams increase drag and reduce hydrodynamic efficiency, which implies reduced range. Higher L/B ratios, on the other hand, indicate better directional stability over long distances, typically associated with longer and thinner hulls.

The Endeavor Manta, as a result of its Trimaran hull and of its dimensions, boasts a low L/B ratio. Its high displacement of 5 tons is counter-balanced by a ratio of only 2.3 when compared to the Kuai Chi's 4.4 or the MAGURA V5's 3.7 L/B ratios.

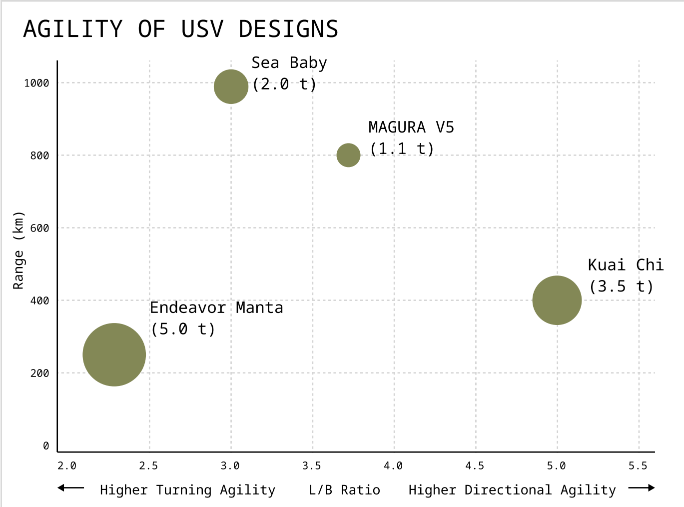


Figure 15. Agility vs. range of USV models.

The Endeavor Manta therefore accepts lower top speeds in exchange for both higher sea-state operability and turning agility, suggesting an emphasis on effective tactical manoeuvring at shorter range. The Kuai Chi sacrifices sharp turning for better navigation over greater distances, in line with its focus on range.

What emerges through Taiwan's mobility design choices are two platforms whose intended area of operations clearly differ. While both have comparably more trafficability at the cost of speed and range when compared to their Ukrainian analogues, the Kuai Chi seems better suited to navigate further from the coasts of Taiwan, while the Endeavor Manta maximises virtues associated with littoral navigation.

Lethality

Beyond mobility, understanding the variations in lethality for these systems is as crucial in understanding their intended tactical use and operational role. We measure lethality based on estimations of payload terminal effects (or the energy delivered against targets upon impact), accuracy, and range.

LETHALITY	KUAI CHI	MAGURA V5	ENDEAVOR MANTA	SEA BABY
Terminal Effect	~200 kg	200 kg—320 kg	450 kg	860 kg

Figure 16. Lethality of primary payloads as measured by weight.

In terms of raw terminal effects, the Sea Baby has 4.3x the explosive payload capacity of the Kuai Chi, which translates to an actual blast radius 1.6x larger than that of the Kuai Chi. The exact effects vary depending on detonation medium and target, but this scale offers general grounds for comparison.

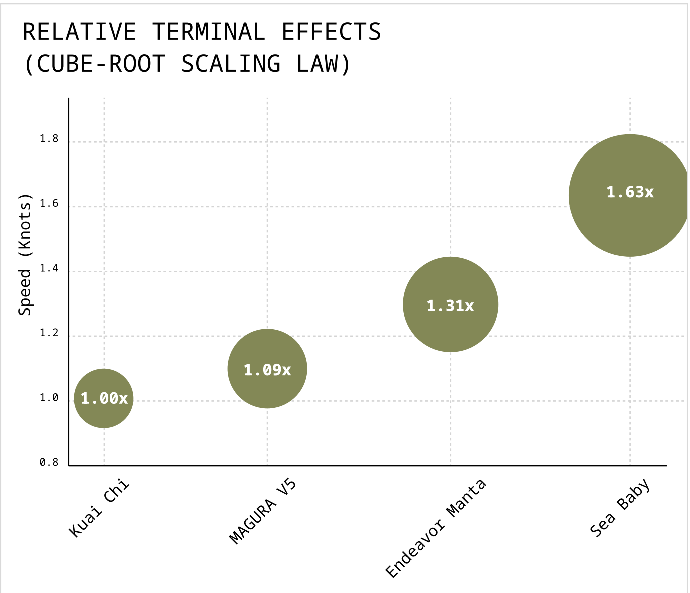


Figure 17. Relative terminal effects of selected USV models.

Under these calculations, we identify a first cluster composed of the Endeavor Manta and Sea Baby, whose focus is on high primary payload terminal effects. We can expect these platforms to be used against larger maritime targets where this focus would yield the most results, with the tactical ends most likely consisting of adversary destruction rather than mission-kill.

As informed by its littoral focus and smaller blast radius, point targets like surface vessels at sea are most likely to be the focus of the Endeavor Manta, as opposed to docked area targets in ports or key infrastructure like bridges against which the Sea Baby has been used against in the Black Sea.

At the other end of the primary terminal effect spectrum, the Kuai Chi and MAGURA V5 systems seem fitted for smaller targets, such as landing craft or missile boats, or to deliver mission and mobility kills on PLAN vessels rather than outright sinking.

In addition to the primary terminal effects expensed as a function of the warhead payload they carry, USVs can host modular payloads capable of delivering secondary effects on targets from a distance.

Carrying such payloads often means reducing the total weight of primary explosive capacity analysed above. As such, terminal effects between primary and secondary payloads are not necessarily cumulative. Nevertheless, the types of secondary weapons which are generally mounted on the platforms offer another opportunity for understanding their tactical use.

In the graph below, their accuracy is analysed against effective range, while the secondary terminal effects are illustrated by the size of the respective bubbles. Accuracy is represented qualitatively due to lack of quantitative data available in open-sources.

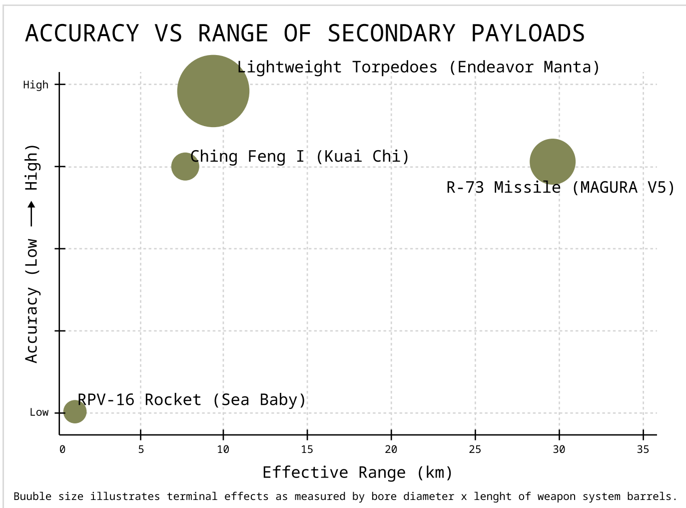


Figure 18. A comparison of accuracy and range for secondary payloads of selected USV models.

Likewise, because of a lack of information on the Endeavor Manta's Taiwanese torpedoes, our analysis is based on the characteristics of the American Mark 54 lightweight torpedoes. The Mark 54 is a good proxy because its size and past acquisitions by the Taiwanese government suggest it or a similar weapon may be fitted on the Endeavor Manta.[58] Whether the torpedoes fielded by Taiwan would focus on anti-submarine or anti-surface warfare is unknown at the time of writing.

Based on these assumptions, the Endeavor Manta's secondary payload reveals high-accuracy capacities against medium-range targets. The Chin Feng I loitering munition, owing to the Kuai Chi, globally mirrors the lower terminal effects observed in its primary payload.

Crucially, secondary payloads reveal vastly different choices in terms of duration of fire. The smaller hull of the Endeavor Manta can only be fitted with two lightweight torpedoes, whereas the Kuai Chi's hull can fit up to six Chin Feng I launchers. The latter, not unlike the Sea Baby's rockets, are likely suited to saturate CIWS, enabling the Kuai Chi's last-mile breakthrough to its target. Torpedoes, on the other hand, can deal critical structural damage to a ship's hull in-and-of themselves. Their standalone lethality imply non-kamikaze use-cases for the USV but require frequent re-supplying.

Survivability

We rely on passive and active hit avoidance as measures of survivability, which are sufficient for the sake of our comparisons and often considered more relevant pointers than hit tolerance. Additionally, analysis of hit tolerance, which is necessary for a complete assessment of survivability, requires access to measurements of armor depth that is unavailable to us at the time of writing.

Every platform observed, other than the Endeavor Manta, share a similar silhouette with beams varying slightly between 1.5 to 2 meters. While data on air draft (measuring the distance from the waterline to the highest point of the ship) is sparse for these USVs, the Endeavor Manta appears on photos slightly taller than its counterparts, and with a much wider beam at around 3.7 meters. Its wider silhouette makes it an easier visual target, though it makes up for this through its stealth design.

While built from glass fiber-reinforced plastic (providing very limited hit tolerance), the Endeavor Manta's hull resembles that of recent American Littoral Combat Ships. The smooth and angular shape of its hull reduces radar cross-section and affords significant survivability by complicating its detection.

Figure 19. Wikimedia Commons. Littoral Ship USS Independence (LCS-2) at Naval Air Station Key West.[59]

Beyond silhouette and hull, virtues like speed, agility, and weapon systems play an important role in estimating survivability through active hit avoidance capabilities. The Sea Baby has clear advantages from its high speed and high agility (L/B ratio of 3.0) while also having cost-effective secondary weapons that can act as saturation options against close-in weapon systems during final approach phases. Together, these significantly increase its overall capacity to reduce its engagement window (during which it may be intercepted), to evade CIWS through turning agility, or to disengage.

58. Army Recognition, "US Approves sale of EW Systems & Torpedoes to Taiwan Navy," June 30, 2017, armyrecognition.com
59. Nicholas Kontodiakos, "USS Independence (LCS-2) at Naval Air Station Key West on 29 March 2010 (100329-N-1481K-298)," photograph (U.S. Navy), March 29, 2010, Wikimedia Commons, uploaded July 28, 2011, commons.wikimedia.org

The Kuai Chi's characteristics are more closely aligned with those of the Sea Baby, albeit at lower performance levels (slower speeds, reduced terminal effects, and a bias toward directional rather than turning agility).

The decision to incorporate stealth into the Endeavor Manta, however, is particularly revealing. It implies a different design philosophy altogether, with an intent to penetrate defended environments, evade detection by ISR, and engage more sophisticated naval or logistical assets. Despite its design allowing for kamikaze missions through its explosive payload, the platform should be understood as a precision tool and ISR node within Taiwan's greater maritime denial architecture.

Sensory Acuity

Taiwanese designs are tailored for an environment with much higher ISR density. The Endeavor Manta shows high levels of tech, with AI-based target recognition and a phased array planar radar included onboard.

The Kuai Chi, on the other hand, relies on the third-party NCSIST Albatros II UAV for target detection, in line with its likely use as an attritable platform intended to act principally as loitering munition. This interpretation is reinforced by its agility specs, suggesting it would be ill-fitted for constant course corrections as would be imposed by automated guidance. The Kuai Chi should therefore be thought of as a weapon system, rather than a standalone platform, meant to interact with a set of ground and air-based ISR guidance to deliver effects at range.

Implications for USV Employment in Taiwan

What emerges from this comparison is a divergence in design philosophy shaped by geography and operational focus.

Ukrainian USVs reflect a doctrine optimized for long-range maritime strike across a large, semi-enclosed sea. Their design prioritizes range, speed, and heavy terminal effects capable of degrading infrastructure and capital vessels at great distances. They assume extended logistics lines, and deep strike missions against unexpecting targets.

Taiwanese platforms, by contrast, are designed for a tight battlespace. Both the Kuai Chi and the Endeavor Manta accept reduced range in exchange for higher sea-state operability and maneuverability within constrained and contested waters. Their mobility profiles suggest an expectation of operating under dense ISR coverage, shorter logistics loops, and proximity to friendly air and missile defense networks, particularly for the Kuai Chi.

Within this framework, the two Taiwanese models diverge further. The Endeavor Manta appears configured as a precision-oriented littoral platform capable of operating stealthily. It depends on more frequent logistical sustainment, but provides better accuracy and higher terminal effects at shorter ranges. The Kuai Chi, on the other hand, presents the characteristics of an attritable strike force. It is reliant on external ISR, optimized for use within a broader architecture of combined systems allowing it to act principally as loitering munition.

These design choices imply that Taiwan's USV concept is oriented toward layered denial meant to thicken the defensive density of the strait itself, with systems tailored to maximizing effects at different layers. The tradeoffs embedded in mobility, lethality, survivability and sensory acuity inform this conclusion.

This raises a defense policy tension, however. If these platforms are optimized for attritable, distributed employment in a smaller but more contested theatre, such a concept would logically require substantial production scale and rapid replenishment capacity, particularly for the Kuai Chi model. Whether Taiwan's industrial output, procurement timelines, and defense budget align with this implied doctrine is examined in the following chapters.

Chapter 5. Blockade Constraints and Industrial Readiness

Taiwan is a highly capable industrialized country with high-tech sectors and considerable industrial output. At the same time, challenges remain in its production of USVs, especially when considering the tight timeline of a possible Chinese invasion of the island. The largest possible challenge for Taiwan's production certainly comes in the form of a possible Chinese blockade. The risk of blockade fundamentally reshapes the logic of defense planning. Once the PRC imposes maritime and air isolation, external resupply collapses and production becomes a closed-system problem.

Under these conditions, endurance is determined by three complementary measures: stockpiling of bottleneck components, reducing reliance on foreign imports, and developing the production capacity to build and maintain a sufficient supply of USVs in a limited time frame. None of these measures is sufficient in isolation. Stockpiles without adaptation invite obsolescence; R&D without physical reserves collapses under attrition; production capacity without input stalls under isolation.

Global Chokepoints: The Raw Material Trap

Because a Chinese blockade would prevent the import of materials essential for manufacturing during a conflict, it is crucial for Taiwan to stockpile necessary materials before any conflict breaks out. Like many nations, Taiwan already holds strategic reserves of petroleum, natural gas, and coal. Yet while energy is one bottleneck in manufacturing, it is not the only one. Despite a high level of technological sophistication, USV production in Taiwan must also face China's near-monopoly over raw materials.

- Taiwan can assemble finished battery modules domestically, but lithium cells and raw materials for these modules (lithium, cathode and anode components) are supplied from China. China controls over 70% of global lithium-ion battery production. Without access to these inputs, USV production would grind to a halt, leaving only empty hulls, as maritime drones require high energy density to overcome currents and cover long distances
- High-performance USV propulsion critically depends on neodymium-iron-boron magnets. Around 85–90% of global processing capacity for these rare-earth materials is concentrated in China. This creates a strategic "noose" for the entire electric propulsion segment[60]

Ukraine faces similar shortages, but these are not existential. Thanks to open land borders with the EU, Ukraine can rely on Western supply chains or diversify sources via "gray" imports. For Taiwan, any delay in material delivery before a blockade would collapse domestic production lines. China is well aware of this dependence. Since the PRC absorbs over 40% of Taiwan's exports and accounts for more than one-fifth of its imports, Beijing possesses levers of influence that could be applied "upstream," meaning at the level of raw materials and semi-finished products, even before open hostilities begin. This enables China to deplete Taiwan's defensive potential in a "gray zone" scenario. Under such a scenario, Taiwan's only recourse is to pivot toward Western-led supply chains. However, while it remains a viable lifeline during a "gray zone" crisis, it becomes a logistical impossibility once a blockade is fully enforced. Thus, if Taiwan wishes to maintain its manufacturing base despite a blockade, it will be crucial to stockpile the critical materials that would otherwise bottleneck the island's manufacturing if absent. A full audit of raw materials critical to Taiwan and a plan for their acquisition is beyond the scope of this report, but it must be conducted if Taiwan wishes to maintain its manufacturing capacity in the face of a blockade.

60. Hong-Lun Tiunn et al., Drones for Democracy: U.S.-Taiwan Cooperation in Building a Resilient and China-Free UAV Supply Chain (Research Institute for Democracy, Society and Emerging Technology [DSET], June 16, 2025), PDF, dset.tw

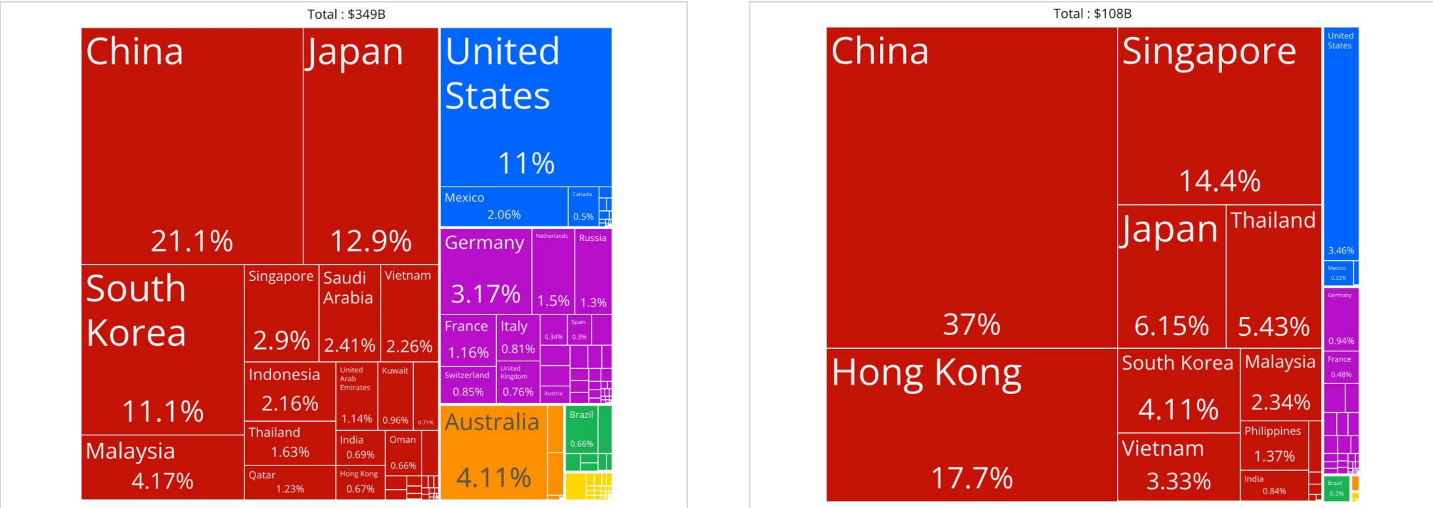


Figure 20. Taiwan's imports (left) and exports (right), as percentages of total trade value, 2024.[61]

The "China-Free" Strategy for critical components

Since 2020, and accelerating after the war in Ukraine, Taiwan has sought to reduce these vulnerabilities by building a "China-free" unmanned systems ecosystem, capable of supporting both national defense and allied supply chains. As one senior Taiwanese national security official involved in drone policy noted, Taiwan must be able to produce and sustain unmanned systems domestically once isolation sets in.

Here Taiwan holds a significant advantage over Ukraine. Taiwan's manufacturing ecosystem benefits from advanced R&D in sensors, controllers, actuators, and transmission components. AI development and software engineering further support autonomous navigation and mission control at the subsystem level. Since 2020, government investment has focused on the "Three Chips and Two Software" framework, referring to flight control, positioning, and communication chips, along with navigation and control software, designed as a subsidizing and standard-setting mechanism to incentivize domestic production.[62]

These efforts aim to reduce reliance on foreign suppliers and lower long-term costs. However, progress has been uneven. Only select modules, such as AI sensor and flight-control components, receive dedicated subsidies, while other critical elements remain under generalized programs.

The Taiwanese Endeavor Manta illustrates the successes and limitations of these domestic opportunities, having been designed to avoid dependence on as many foreign components as possible. While relatively successful in achieving this end compared to analogue programs, it remains reliant on foreign components for its satellite guidance and its propulsion system. While these are not imported from the PRC, they remain a persistent vulnerability for indigenous USV production.[63]

61. The Observatory of Economic Complexity (OEC). www.oec.world
62. Tiunn et al., Drones for Democracy.
63. Tin Pak, "Taiwan's USV Development and Strategic Learning from Ukraine," Center for Maritime Strategy (The MOC), June 6, 2025, centerformaritimestrategy.org

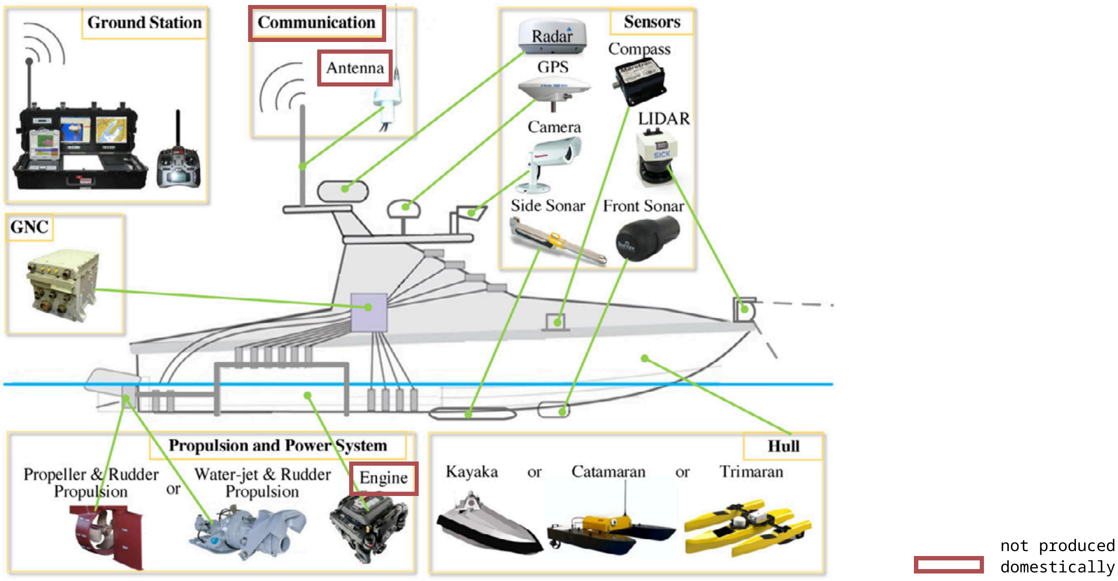


Figure 21. Center for Maritime Strategy. Key components of a USV.[64]

Infrared sensors, secure long-range communications modules, critical chips for control, positioning, and communication, along with selected software-defined systems remain reliant on suppliers from the United States, Europe, and Japan. Taiwan has pursued licensing agreements, joint production arrangements, and international partnerships to mitigate these gaps, but even under optimistic assumptions, near-term substitution of all foreign inputs remains unlikely. A stark illustration of this dependency is found in thermal and optical sensors.

Military-grade thermal cameras (≥640×480 resolution) are essential for navigation and targeting in the Taiwan Strait's frequent fog. These remain controlled under U.S. ITAR regulations. Taiwan's inability to independently meet these specifications degrades situational awareness and strike accuracy in contested littorals.[65] While it appears that Taiwan is seeking to reduce reliance on foreign components, full autonomy remains difficult to achieve.

The Industrial Challenge

The decisive question is not whether Taiwan can build USVs, but whether it can field them in sufficient numbers before the onset of conflict. Empirical benchmarks suggest that this threshold is high. Across CSIS Taiwan invasion wargames, successful defense scenarios involve 113–138 Chinese naval losses.[66]

Using the upper bound and applying a conservative ratio of 10 USVs per target, which is the highest documented attack density on a single warship observed in the Ukrainian case (Caesar Kunikov/Ivanovets), we estimate a required stockpile of approximately 1,100–1,400 strike USVs. This figure excludes additional losses inflicted by coastal missiles, mines, aviation, and artillery before USVs deploy.

64. de Andrade, E. M., Sales, J. S., Jr., & Fernandes, A. C. (2025). Operative Unmanned Surface Vessels (USVs): A Review of Market-Ready Solutions. Automation, 6(2), 17. doi.org
65. Tiunn, Fang, Lai, Li, & Sun, Drones for democracy.
66. Mark F. Cancian, Matthew Cancian, and Eric Heginbotham, The First Battle of the Next War: Wargaming a Chinese Invasion of Taiwan (Washington, DC: Center for Strategic and International Security Studies, January 2023), 94, csis-website-prod.s3.amazonaws.com

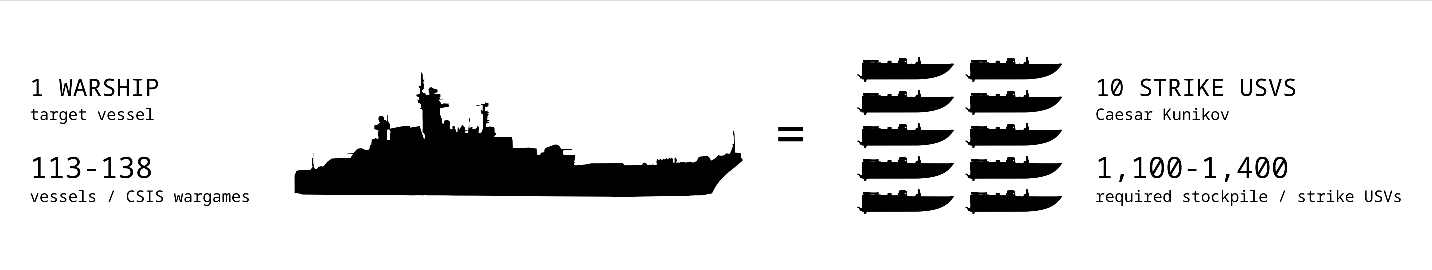


Figure 22. Comparison of required Chinese naval losses with minimum required USV stockpile.

When factoring in probable early losses, the figure likely rises. Losses to Chinese missile barrages and port suppression are highly likely in the opening chapters preceding the invasion. Assuming a best-case scenario of 25% loss rate, Taiwan would need to procure roughly 1,500–1,900 USVs in total to preserve an operationally viable strike inventory.

Under a more pessimistic assumption of 75% loss rate, the total procurement requirement rises to approximately 4,400–5,600 platforms. While the true figure most likely falls somewhere in between these numbers, they do imply a requirement for increased industrial and financial commitments from Taipei.

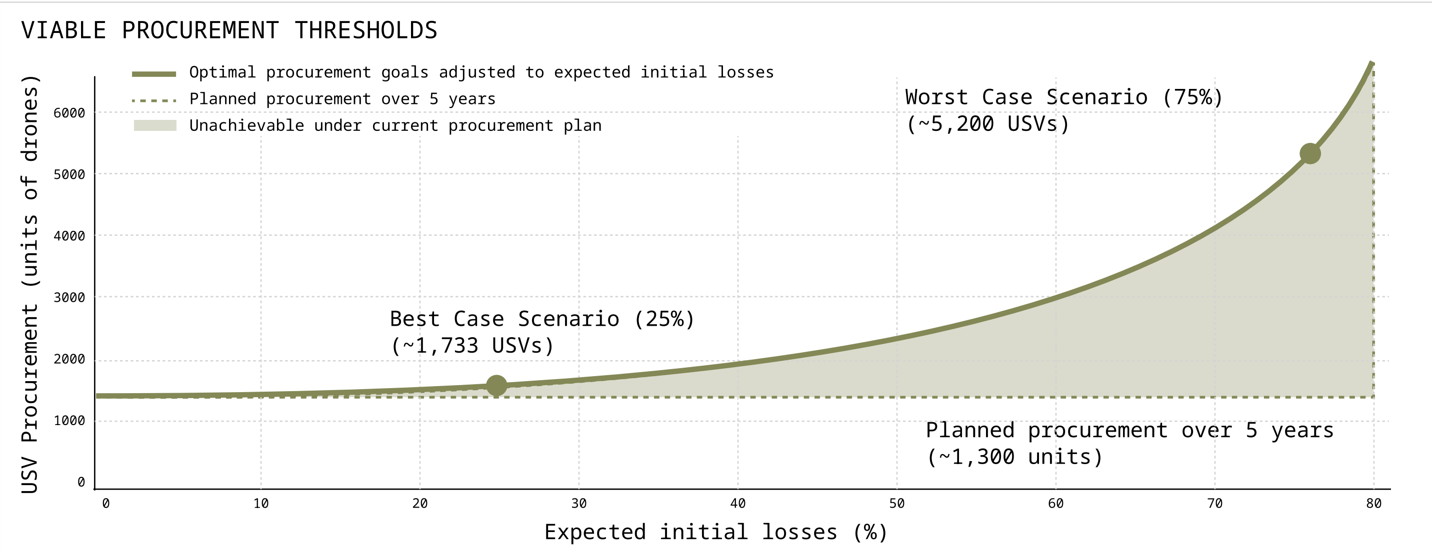


Figure 23. Comparison of optimal procurement thresholds to maintain operational viability under different initial loss rate estimates.

Programmatically, Taiwan is transitioning from experimentation toward initial mass production. As of 2025, neither platform has entered operational naval service, though Endeavor Manta and Kuai Chi have completed live-fire testing and the latter has been selected for series procurement planned for 2026. In mid-2025, public reporting indicated that Taiwan planned to acquire over 1,300 Kuai Chi USVs over five years.[67] A few months later, updates to Taiwan's special defense budget clarified that funding would allow for up to 1,600 USVs with the NCSIST acting as prime integrator and external cooperation (such as with U.S. firm MARTAC) intended to accelerate development.[68]

Even on an optimistic timeline, assuming serial production begins in 2026, reaching a stockpile of 1,400 USVs would require an average output of approximately 23 units per month. At this rate, the minimum effective USV fleet would not be available until 2029–2030 under steady production. Real production tempos currently fall short of targets, while political and economic pressure from China could intensify well before the five-year acquisition window is completed.

The Ukrainian experience with maritime drones offers a clear empirical benchmark for assessing production tempo under pressure.

67. Giulia Bernacchi, "Taiwan to Build Over 1,300 Kuai Chi Uncrewed Surface Vessels: Report," The Defense Post, August 26, 2025, thedefensepost.com
68. Giulia Bernacchi, "Taiwan Eyes 1,600 Unmanned Attack Vessels Under $39.8B Defense Plan," The Defense Post, December 29, 2025, thedefensepost.com

The Sea Baby project is publicly known to have begun in July 2022, with its first combat use already in mid-September 2022, when five drones were deployed in an initial operation. A second attack followed in October 2022, involving seven drones. By December 2022, Ukrainian sources publicly announced a fundraising campaign to produce 100 maritime drones, signaling a rapid shift from experimentation to batch production.[69] The next publicly acknowledged fundraising effort appeared only in February 2024, targeting an additional 35 Sea Baby drones.[70] These figures reflect only what has been publicly disclosed; actual production is likely higher but cannot be independently verified.

The MAGURA series provides a more traceable record of operational use. The first confirmed attack occurred on 24 May 2023, when three MAGURA drones targeted the Russian reconnaissance ship Ivan Khurs. Subsequent attacks were recorded at roughly one- to two-month intervals through late 2023. A sharp escalation took place in February–March 2024, when Ukrainian forces launched ten drones against Ivanovets (February 1st), ten against Caesar Kunikov (February 14th), and five against Sergey Kotov (March 5th), totaling 25 drones within approximately one month. During the remainder of 2024, at least six additional MAGURA attacks were publicly reported.

Taken together, publicly documented operations between May 2023 and May 2024 confirm the combat use of at least 36 MAGURA drones. Ukrainian officials have stated that up to 70 percent of maritime drones may be destroyed during an attack, implying that visible combat use represents only a fraction of total launches.[71] We therefore estimate that over 100 MAGURA drones were deployed over a twelve-month period. This estimate covers only drones launched in combat and excludes units lost during testing, training, or held in reserve, indicating a substantially higher underlying production and sustainment capacity.

According to the US Naval Institute, Ukrainian manufacturers have stated that, if required, they are capable of producing up to 50 maritime drones per month, reflecting the needs of observed operational deployment.[72]

At such a rate, Taiwan would meet its minimum requirement in three years. Its challenge, however, is to convert its prototypes' success into sustained, scaled production that can survive both peacetime budget limitations and wartime attrition. The window between the start of production and the onset of conflict becomes more narrow everyday, and Taiwan must bring up the industrial will to transform its prototypes into a credible force and deterrent rapidly.

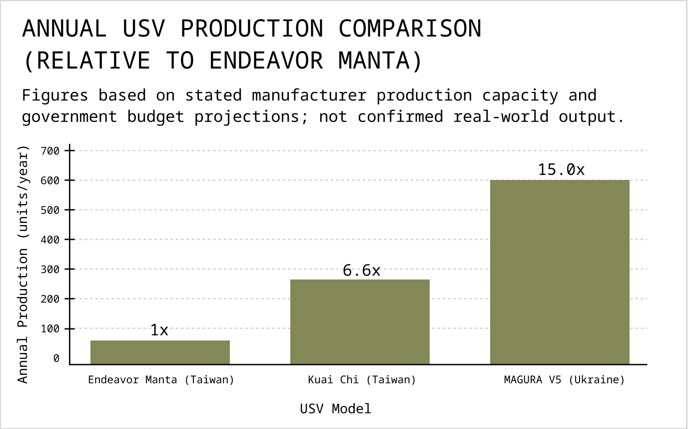


Figure 24. Annual USV production comparison.

Taiwan's difficulties in scaling USV production reflect structural limitations across the defense sector. Taiwan faces persistent shortages of skilled labor, partly driven by long-term brain drain. According to Drones for Democracy (DSET), which studied analogous challenges in Taiwan's UAV sector, several structural constraints are particularly relevant to USV scaling:

- **Reliance on non-PRC components raises unit costs.** Taiwan's programs rely on imports from allied countries for critical components, such as SDR video transmission chips, flight control and positioning chips, thermal cameras, and gimbal modules. Some of these chips can cost up to 10 times more than comparable Chinese alternatives
- **Limited domestic and foreign procurement** restricts production experience and economies of scale. Government orders are modest, while foreign procurement is constrained by lack of internationally recognized certifications, competition from low-cost Chinese systems, and limited access to U.S. and European defense acquisition channels

69. Ministry of Digital Transformation of Ukraine, "Понад 200 млн гривень вже зібрали на перший у світі флот морських дронів" [Over UAH 200 million has already been raised for the world's first fleet of naval drones], November 15, 2022, thedigital.gov.ua
70. UNITED24, "This Is Battleship. Your Donation Is Your Play," accessed February 28, 2026, u24.gov.ua/seababy.
71. Militarnyi, "До 70% морських дронів України знешкоджуються під час операцій" [Up to 70% of Ukraine's naval drones are neutralized during operations], accessed February 28, 2026, militarnyi.com
72. Eric Wertheim, "Ukraine's MAGURA Naval Drones: Black Sea Equalizers," Proceedings 151, no. 9 (September 2025) (Vol. 151/9/1,471), www.usni.org

Chapter 6. Launch, Storage, and Logistical Constraints

While producing and stockpiling USVs is one half of the issue, getting them into the water, concealing them, and sustaining them under fire presents the other. Any amount of pre-war stockpiling would not automatically translate into combat effects unless Taiwan could reliably generate sorties at scale. Due to geographic constraints, this problem will require creative solutions.

In the Taiwanese context, the most practical method of launch is from shore, by unloading the unmanned system directly from a vehicle and into the water. This requirement narrows viable launch options to water-accessible points along Taiwan's western coastline.

This coastline is densely populated and highly developed. Over 90% of Taiwan's population resides on the western side of the island, and much of the coastline is dominated by ports, industrial zones, fishing harbors, or urban waterfronts. Unlike Ukraine's southern coast, which includes river deltas, estuaries, and semi-enclosed littorals suitable for concealed launches, most Taiwanese west-coast launch points are directly exposed to the Taiwan Strait. This exposure creates two problems:

- **Persistent ISR exposure:** Fixed launch sites are observable by satellite, maritime patrol aircraft, UAVs, and surface sensors
- **Limited sortie density:** Even mobile launch concepts require physical preparation time and repeated use of the same access points, quickly generating detectable patterns

The necessity to launch several USVs for single coordinated strikes implies that each viable launch site must support multiple platforms simultaneously, making it a high-value target once identified.

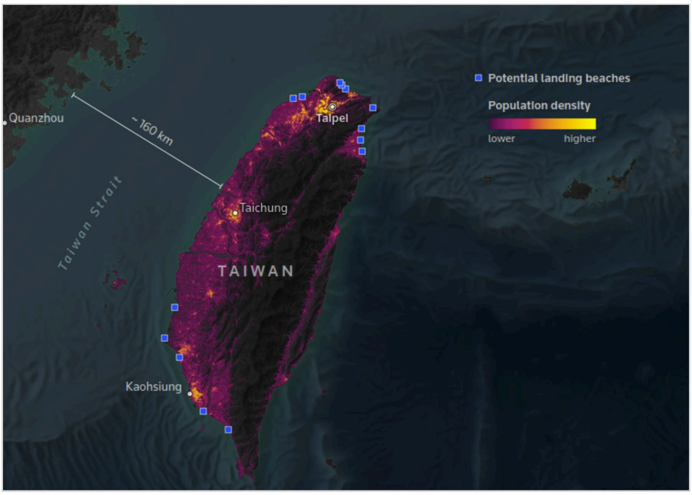


Figure 25. Reuters. Population density and strategic locations in Taiwan.[73]

Taiwan's outlying islands, including Kinmen and Penghu, offer theoretical forward deployment options but impose severe physical and operational constraints. To function as a meaningful launch node, an island would need to concentrate several elements simultaneously:

- Pre-positioned USV stocks, including spares and munitions
- Storage infrastructure, ideally hardened or concealed, which is difficult to construct at scale on small, flat, and well-observed islands
- Logistics and internal transport, including vehicles capable of moving USVs from storage sites to launch points
- Trained personnel to prepare, launch, and coordinate operations
- Reliable command-and-control connectivity

From a logistical perspective, pre-war forward deployment to Taiwan's outlying islands is feasible. The navy operates roll-on/roll-off landing craft capable of transporting USVs from the main island. Departing from Kaohsiung, a single Newport-class landing ship could carry approximately 20 Kuai Chi USVs per sortie, while a Chung Hai-class tank landing ship could transport around 10, based on simple measurements for beam and length of the respective vessels given the dimensions of the Kuai Chi.[74]

73. Original data from the 2025 Global Human Settlement Population Layer (European Commission, Joint Research Centre [JRC]; GEBCO; Project 2049 Institute), as visualized by Allison Martell et al., "Shadow Navy: How China's Civilian Fleet Could Be a Potent Weapon in a Taiwan Invasion," Reuters Graphics, November 20, 2025, www.reuters.com
74. Sharpe, R. (Ed.). (1990). Jane's fighting ships 1990–91 (93rd ed.). Jane's Information Group.

Transit times range from 3.5 to 6 hours to Penghu and from 7 to 13 hours to Kinmen, depending on vessel type. Penghu would be logistically preferable. Located roughly 70 nautical miles from Kaohsiung, compared to Kinmen's 156 nautical miles, it offers industrial ports, an airfield, and road infrastructure capable of supporting heavy vehicle movement between storage sites and launch points. Kinmen, by contrast, lacks large industrial ports and major roadways, significantly complicating internal logistics.

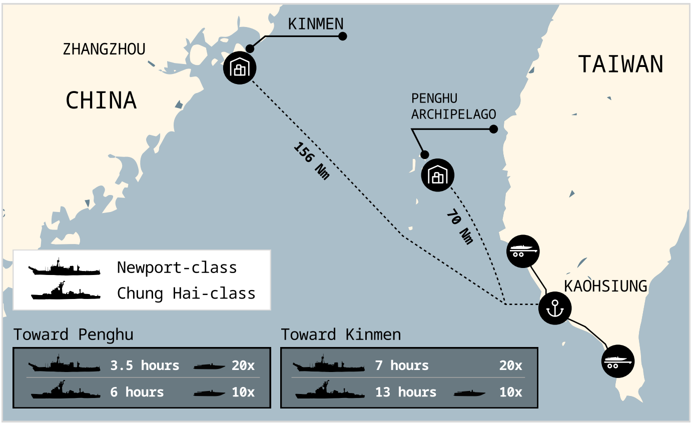


Figure 26. Estimated transit times of ROCN vessels to reach forward deployment points Penghu and Kinmen.

While these islands could host limited pre-positioned USVs, their small size and limited infrastructure severely constrain their ability to function as sustained launch hubs. The Penghu archipelago covers only 127 km², while Kinmen is even smaller and lies just kilometers from the Chinese mainland.[75] Limited road networks and short internal distances make vehicle movement, preparation, and repeated launch activity easy to observe, while storage facilities, whether above or below ground, would be easily identified and vulnerable. Sustaining operations would require the continuous presence of launch crews and maintenance personnel on the islands, concentrating both human and material assets in a confined and exposed area. Wartime resupply of fuel, replacement systems, or personnel across contested waters would prove difficult. Command-and-control further compounds these challenges: remote control from Taiwan's main island depends on communications links susceptible to jamming, interception, or physical disruption. Kinmen's partial reliance on undersea telecommunications cables, connected to China, amplifies these risks.

For these reasons, outlying islands are better suited for limited pre-war dispersal, deception, or temporary staging. Similarly, launching strike-capable USVs from third-country territory, such as the Philippines or other regional partners, would represent a major escalation of the conflict. Partner states are unlikely to provide launch infrastructures once hostilities begin. As a result, the primary burden of USV launch operations falls on Taiwan's main island.

One potential solution involves launching USVs from Taiwan's mountainous Eastern coast. While this may be feasible, the journey around the island is too long for current Taiwanese USVs. As discussed in Chapter 4, these systems sacrifice the range necessary to circumnavigate the island for the trafficability required to survive the area's rough sea state. Additionally, the long journey would greatly increase the chances of the USVs being observed by Chinese ISR.

Storage of USVs presents an additional, equally binding limitation. USVs are physically large systems, typically 5–7 meters in length, and require substantial space. Even when storage is dispersed across multiple locations, accommodating and sustaining a force of 1,000 USVs would require tens of thousands of square meters of infrastructure, along with trained personnel and ongoing maintenance support.

The logistics chain from storage to launch is exposed and time-sensitive. USVs must be trucked from storage to beaches, unloaded, prepared, and launched within a narrow window, which creates detectable movement patterns and reveals launch points and storage locations. Effective USV employment, therefore, requires a geographically distributed network of depots, ideally situated close to multiple potential launch points and supported by non-intersecting road networks. These depots must be dispersed enough to avoid catastrophic losses from concentrated strikes, yet sufficiently numerous and well-prepared to sustain repeated operations. Building, protecting, and integrating such a network requires consistent pre-war investment and planning.

Thus, while Ukraine has demonstrated the possibility of covertly storing and launching USVs, the Ukrainian "blueprint" does not translate cleanly onto Taiwan's geography. These challenges will require creative solutions if Taiwan wishes to succeed in USV warfare as Ukraine has.

75. Encyclopædia Britannica, "P'eng-hu Islands," n.d., britannica.com

Chapter 7. Defense Environment

Possessing a stockpile of USVs and being capable to launch it are crucial steps, but for continued success, understanding the capacities of the PLAN and the capabilities of its vessels is imperative. The PLAN's surface combatants are not analogous to the aging Soviet-era vessels Ukraine has engaged in the Black Sea. They are newer, better integrated, and equipped with layered defensive architectures. This chapter assesses those layers systematically, from kinetic measures through sensors, radars, and EW capabilities. We juxtapose lessons derived from Ukraine with the defensive architecture of PLAN surface combatants involved in escort, protection, and sustainment operations. These are most notably performed by Type 054A frigates, Type 052D destroyers, Type 055 cruisers, and, to a lesser extent, corvettes operating near high-value assets. While defensive configurations vary by platform and generation, these ships often field a layered defensive architecture more capable of challenging unmanned surface vehicles than the systems observed on Russian vessels.

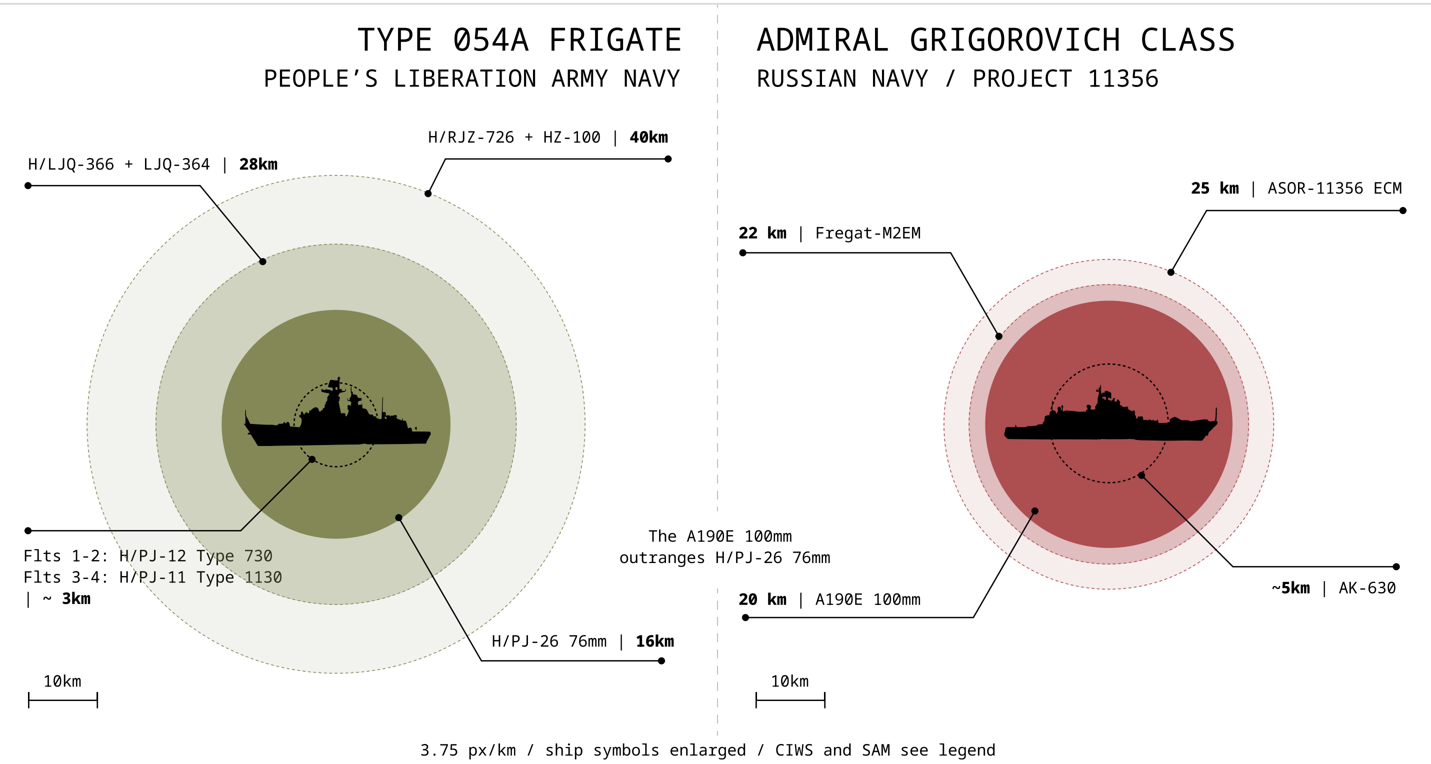
The first layer of defense is built around close-in weapon systems designed to counter fast-moving systems at close range. On larger combatants such as the Type 054A, this role is performed by the H/PJ-11 (Type 1130) CIWS. Supported by advanced fire-control radars and electro-optical trackers, it is more capable of detecting and engaging low-profile surface targets than the Soviet-era systems directing most Russian AK-630 mounts.[76,77] On smaller Chinese corvettes, Type 730 CIWS, such as the H/PJ-12, provide similar functions, albeit with lower but still substantial rates of fire.[78,79] Crucially, these systems are digitally integrated into modern combat management systems, allowing automated cueing fed from radar and electro-optical sensors and reducing reaction times compared to manual visual tracking.

Besides CIWS, Chinese vessels also mount medium-calibre dual-purpose naval guns. The H/PJ-26 76-mm gun fitted to platforms such as the Type 054A is a modernised derivative of the Soviet AK-176, featuring a redesigned turret and enhanced automation.[80] When paired with modern fire-control radars, this class of weapon provides an effective medium-range defense layer, with the ability to engage surface targets at distances of up to approximately 16 kilometres.

In the domain of sensor and electronic warfare integration, Chinese ships also have an advantage over their Russian counterparts. Modern PLAN ships are typically outfitted with 3D air/surface search radars such as the H/LJQ-382 and advanced surface-search suites like the LJQ-366. In comparison with the older Soviet-era radars carried by most Russian vessels in the Black Sea, they are able to track and identify incoming drone boats at greater range. When it comes to electronic warfare, systems such as the H/RJZ-726 fitted to Type 054A frigates provide more modern jamming capabilities that could interfere with the datalinks used to control USVs.[81]

From 2023 onward, Russian EW assets actively attempted to disrupt Ukrainian USVs, jamming GPS and communications with systems like Pole-21 and R-330 Zhitel. Ukrainian operators adapted by adding redundant communication channels, inertial navigation systems, and preprogrammed attack paths, allowing drones to complete missions even when external signals were lost. They also layered offensive EW measures against Russian sensors and cameras to degrade situational awareness and create "digital smoke" for the drones. While EW can complicate unmanned operations, resilience, redundancy, and adaptive tactics can maintain operational effectiveness even against sophisticated countermeasures.

76. Seaforces.org, "Type 054A Jiangkai II class guided missile frigate – China Navy (People's Liberation Army Navy)," n.d., www.seaforces.org
77. WeaponSystems.net, "30mm H/PJ11," n.d., weaponsystems.net
78. MilitaryDrones.org.cn. "Type 022 Missile Boat." n.d., militarydrones.org.cn
79. WeaponSystems.net. "30mm H/PJ12." n.d., weaponsystems.net
80. GlobalSecurity.org. "PJ26 (H/PJ26) 76mm Naval Gun." n.d., globalsecurity.org
81. Seaforces.org. "Type 054A Jiangkai II Class Guided Missile Frigate – China Navy (People's Liberation Army Navy)." n.d. seaforces.org



LAYER	PLAN — TYPE 054A FRIGATE	ADMIRAL GRIGOROVICH CLASS
EW/JAMMING	H/RJZ-726 | HZ-100 ECM/ELINT | Kashtan-3 jammer | ~ **40km**	ASOR-11356 ECM (primarily passive) | PK-10 decoy | ~ **25km**
SURFACE SEARCH RADAR	H/LJQ-366 surface + H/LJQ-364 sea/low-alt | ~ **28km**	Fregat-M2EM air/surface search | ~ **22km**
MAIN GUN	H/PJ-26 76mm DP | Type 347G FC | **16km**	A190E 100mm | 5P-10E FC | 80 rds/min | **>20km**
CIWS	Flts 1-2: H/PJ-12 Type 730 | 4,200 rds/min Flts 3-4: H/PJ-11 Type 1130 | 11,000 rds/min | ~ **3km**	AK-630 | 5,000 rds/min | **~5km**
SAM (NOT SHOWN)	H/AKJ-16 VLS | HQ-16 | ~ **70km** (anti-air primary)	Shtil-1 | 9M317ME | **3.5-32km** (anti-air primary)

Figure 27. Defense layers of PLAN and VMF ships.[82,83]

Overall, China fields a significantly more advanced and better integrated shipboard defensive architecture than that employed by Russian forces in the Black Sea. Chinese surface combatants combine higher levels of automation, faster reaction cycles, and tighter integration between sensors and weapons, reducing their reliance on human operators under time pressure.

While the PLAN lacks direct combat experience against sustained USV campaigns, it has had the opportunity to observe Ukrainian maritime drone operations closely and incorporate those lessons preemptively, contrary to Russia whose fleet was unprepared to face this threat.

82. "Project 11356 Admiral Grigorovich Class Frigates," Naval Technology, May 2026, Project 11356 Admiral Grigorovich Class Frigates
83. "Type 054A Jiangkai II Class Guided Missile Frigate," SeaForces.org, 2026, Type 054A Jiangkai II class Missile Frigate PLAN Navy China

This advantage already manifests in how the Chinese industry has translated observed lessons into concrete counter-USV capabilities. China's defense sector, including NORINCO, has unveiled armed unmanned surface platforms such as the UB1 Sharp Shark 10, designed explicitly for engaging small surface threats, equipped with remote weapon stations in the 12.7–14.5 mm class and vertical launch cells for additional munitions.[84] In parallel, the PLA is fielding portable and short-range radar systems optimized for detecting low-profile targets including UAVs and surface drones as exemplified by the YLC-48 "UAV Terminator." It is integrating these sensors into broader networks that fuse radar, EO/IR, automated target recognition, and AI-assisted data processing.[85] A further complicating factor for USVs is the growing role of airborne drones, particularly loitering or cueing UAVs with terminal guidance that perform well against sea clutter and can close detection gaps in shipboard sensors.

The Ukrainian experience nevertheless demonstrates an important structural point: even layered and diverse defensive measures ranging from CIWS, medium-calibre guns, and electronic warfare to physical barriers, harbour fortifications, coastal fires, and aviation have been unable to reliably stop maritime drone attacks. In practice, repeated and coordinated strikes have tended to overwhelm both human decision-making and automated defensive systems, allowing at least some vehicles to penetrate and achieve mission effects despite high loss rates.[86]

The effectiveness of wave-based attacks against well-defended vessels has become clear in the Black Sea. In the case of the missile corvette Ivanovets (Project 12411M), USVs were divided into a forward element, approaching from multiple directions in a staggered sequence, and a small reserve. Each maneuver forced the crew to respond to one threat, only to face the next seconds later. Despite the engagement of AK-630 CIWS, the late detection and high speed of the drones left little time to react.

The lead drones struck in rapid succession, with one detonating near the stern, a second hitting the port quarter twenty seconds later, and a third amidships shortly after. The ship was sunk. Two weeks later, up to ten USVs attacked the BDK Caesar Kunikov (Project 775 Ropucha). Four were destroyed, but a hit to the stern immobilized the vessel, allowing subsequent drones to strike port side. With subsequent drones aiming for the initial breach, the BDK Caesar Kunikov was, in turn, ultimately sunk.

For Taiwan, these cases point to a clear and demanding conclusion rather than an easy prescription. Against a more capable and automated Chinese defensive environment, saturation remains essential: if roughly ten USVs are required to reliably overwhelm the defenses of a single high-value surface combatant, then any credible campaign would demand thousands of drones ready at the outset. At the same time, mass alone is insufficient. Low observability, delayed detection, and compressed reaction timelines become equally critical in order to blunt the advantages of faster sensors, automation, and integrated fire control. This places a premium on coordinated, multi-axis approaches and the exploitation of environmental factors, such as sea state, weather, clutter, and visibility to degrade sensor performance and buy time. These observations justify some of the design choices observed in chapter 4. The respective focus of Taiwanese USV models, on stealth and saturation in particular, are appropriate given the means of lethality and sensory acuity employed by the PLAN. By itself, however, individual design features and USV assets are unlikely to be sufficient.

Successful strikes will require combined arms attack and coordination, marshalling offensive EW, missile strikes, and deception operations alongside USVs to maximise success. Taiwan will need to overload the more sophisticated defensive systems of the PLAN, likely requiring more deliberate tactics in its USV employment than has been observed in Ukraine.

84. H. I. Sutton, "New Chinese Maritime Drone: UB1 Shark-10," Covert Shores, January 23, 2026, hisutton.com
85. Tye Graham and Peter W. Singer, "China's Counter-UAV Efforts Reveal More Than Technological Advancement," Defense One, May 2, 2025, defenseone.com
86. Snake Island Institute, The Black Sea's Asymmetric Blueprint.

Chapter 8. Operational Concept: USVs as a Tool of Tempo Degradation

Given the scale of China's vast, replenishable resources and industrial base, USV strikes should be focused on high-value enablers whose loss or delay seriously disrupts the sequencing of an amphibious attack. This focus frames the following analysis, highlighting:

- The PLA Navy's maritime course of action and structural vulnerabilities
- Target prioritization by identifying ships whose neutralization or delay may have the greatest operational impact
- Optimal engagement windows: phases of transit where USVs can create maximal effects

Target Prioritization: Where Damage Is Most Painful

Target prioritization in a USV-centered campaign is driven by two factors: the role of a platform or asset within the overall amphibious campaign, and the relative ease with which it can be disabled. Rather than seeking the physical destruction of high-end combatants, the primary objective is to induce mission kill, or the loss of functional utility at a critical moment. In a time-dependent cross-strait operation, even limited disruption can generate cascading operational effects, delaying follow-on waves, degrading sustainment, and ultimately eroding campaign tempo. From this perspective, priority targets are not those that are symbolically valuable or tactically impressive, but those that represent structural weak points within the invasion system.

Primary Priority Targets

I. Large and Medium Amphibious Ships

Despite variations in generation and configuration, these ships share several characteristics that shape their vulnerability profile:

- Large physical and radar signatures
- Moderate to low transit speeds
- Limited organic defenses during movement, particularly against surface-level, low-observable threats

Functionally, these vessels are optimized for repetitive cross-strait transport; as a result, damage to a single platform can generate cascading effects, including delays, rerouting, and replanning, affecting follow-on waves and overall assault timing.

A particularly relevant point of reference for a Taiwan scenario is Ukraine's targeting of Ropucha-class landing ships (Project 775) in the Black Sea. Designed and built in the Soviet Union, these vessels carried limited defensive systems and proved vulnerable to fast-moving USVs. Within the PLAN, the Type 072 family of landing ships (Type 072A, 072II, 072III, and 072IIIHG) performs an analogous amphibious lift role and represents the numerically dominant component of China's ship-to-shore transport capacity.

Ukrainian combat cases help clarify the distinction between disruption and destruction for this class of platforms. In the attack on Olenegorsky Gornyak, only one USV caused damage, reportedly breaching multiple watertight compartments. Although the vessel did not sink, open-source imagery showed it listing heavily and being towed to port, strongly indicating that it was rendered temporarily combat-ineffective and removed from operations. By contrast, the destruction of BDK Caesar Kunikov required a coordinated, multi-wave effort: ten USVs were committed, four were destroyed, and six achieved impacts. For a Taiwan scenario, this suggests that mission-level disruption may require substantially less coordination and resources than outright destruction, making it the more operationally relevant objective.[87]

87. AstraPress [@astrapress], "При атаке на Новороссийск поврежден десантный корабль «Олененгорский горняк», - российские военные паблики и военные аналитики. В сети публикуют фото и видео, на которых видно, что корабль тащат на буксире. [During an attack on Novorossiysk, the landing ship Olenengorsky Gornyak was damaged, according to Russian military public pages and analysts. Photos and videos circulating online show the ship being towed.]," Telegram post, October 22, 2025, t.me/astrapress/.

Table 4. PLA Amphibious Vessels Relevant to Taiwan Scenarios.[88]

FUNCTIONAL GROUPING	VESSELS (AMOUNT IN SERVICE)	ROLE
I. Amphibious Assault Platforms	PLA Navy • Type 075 [Yushen] (4) • Type 071 [Yuzhao] (8)	Core of the maritime amphibious component; command and control, helicopter operations, and delivery of heavy equipment.
II. Landing Ship Tanks	PLA Navy • Type 072A (9), 072B [Yuting II] (6) • Type 072III (5), 072IIIHG [Yuting I] (5) • Type 072II [Yukan] (3)	Mass delivery of armored vehicles, cargo, and personnel directly to the shoreline or via port areas.
III. Medium Landing Ship	PLA Navy • Type 073A [Yunshu] (10) • Type 073III [Yudeng] (1)	Second-echelon lift, resupply, reinforcement, and logistical buildup following the initial landing.
IV. Tactical Landing Craft (LCM/LCU)	PLA Navy • Type 074 [Yuhai] (15) • Type 074A [Yubei] (10) PLA Ground Forces • Type 074HKG [Yuhai] (3)	Tactical landings, maneuver between ships and shore, and auxiliary tasks.
V. High-Speed Air-Cushion Landing Craft (LCAC-type)	PLA Navy • Project 1232.2 Zubr / Type 958 (6) • Type 726 (3), Type 726A [Yuyi] (13)	Bypassing beach constraints and enabling rapid delivery across shallow waters and obstacles.
VI. Specialized Amphibious Support & Engineering Craft	PLA Navy • Type 724 [Payi] (20) PLA Ground Forces • Type 68 [Yunnan II] (35) • Type 69 [Yupen] (~70) • Yujiu (2+) • Yutu (~20) • Type 271IID [Yuwei] (~100) • Yubu (7)	Engineering support, crossings, shoreline works, and auxiliary functions.

Numbers in parentheses reflect estimated in-service vessels; broader counts may be higher depending on inclusion criteria.

88. Erickson, Kennedy, and Martinson, Chinese Amphibious Warfare.

II. Logistic Vessels

PLA logistics support for a cross-strait campaign encompasses a broad set of functions, including troop and equipment transport, ammunition and POL supply, medical evacuation, engineering and port repair, maintenance and towing, and the protection of maritime lines of communication. While the overall operation would require coordination of 550 to 700 logistics ships, landing ships, and transport aircraft, the number of vessels capable of performing specific, critical tasks is relatively limited. For example, at sea, replenishment of combatants is primarily supported by dedicated auxiliaries including nine Type 903A replenishment oilers and two Type 901 fast support ships, capable of sustaining roughly 20–30 surface combatants for only two to three weeks without external resupply. These ships prioritize capacity over survivability, operate on predictable routes, and have limited tolerance for disruption.

China's military–civil fusion framework extends this logistics base through civilian shipping. Roll-on/roll-off (Ro-Ro) ferries, shallow-draft cargo vessels, container ships, bulk carriers and commercially operated auxiliaries which could be mobilised to provide mass lift and follow-on sustainment beyond the initial assault phase. Open-source assessments of PLA planning, such as those compiled by Reuters, highlight how Beijing places emphasis on integrating commercial maritime capacity into broader invasion concepts precisely because of the limited organic amphibious and sealift assets.[89] These platforms, however, share critical structural vulnerabilities:

- Most civilian vessels rely on a single engine room. This lack of redundancy means one successful strike can halt all power and specialized functions, such as the hydraulic ramp operations essential for Ro-Ro offloading. The tanker SIG illustrates this dynamic: following a single Ukrainian USV strike to the engine compartment, the vessel lost propulsion due to damage and flooding in the power plant section. In effect, the ship suffered a total mission kill despite remaining afloat.[90] While a warship might survive such a hit due to redundant systems, these "soft" targets can be rendered operationally ineffective by a single well-placed hit
- Minimal close-in weapon systems or electronic warfare capabilities make them soft targets for USVs or other low-cost threats. There are cases where China has installed defensive systems, such as the LY-1 high-energy laser, on civilian vessels, but these remain experimental and do not compare to the layered defenses of a purpose-built warship[91]
- Dependence on fixed loading points and predictable duration of crossings make the civilian-military logistics relay highly exposed to ambush

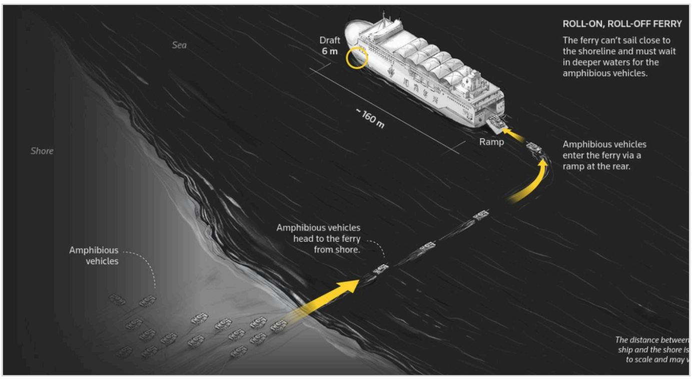


Figure 28. Reuters. RO/RO ferries operate in deeper waters and rely on amphibious vehicles for ship-to-shore transfer.[92]

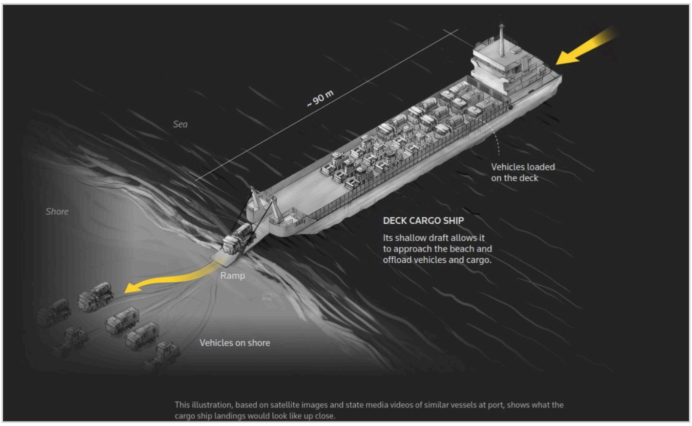


Figure 29. Reuters. Shallow-draft cargo vessels can offload vehicles directly onto the beach via ramps.[93]

89. Allison Martell, David Lague, Clare Farley, and Minami Funakoshi, "China's shadow navy trains to take Taiwan," Reuters, November 20, 2025, reuters.com
90. Defense Express, "Атака на російський танкер Sig: чому так не може навіть протикорабельна ракета і скільки ще є цілей [Attack on a Russian SIG tanker: why even an anti-ship missile couldn't do this and how many targets are left]," Defense Express, August 5, 2023, defence-ua.com
91. Teoman S. Nicanci, "China Converts Civilian Cargo Ship Into Maritime Directed-Energy Platform With LY-1 Laser Weapon," Army Recognition, December 7, 2025, armyrecognition.com
92. Martell et al., "China's shadow navy trains to take Taiwan."
93. Martell et al., "China's shadow navy trains to take Taiwan."

III. Semi-Fixed Maritime Infrastructure

PLA planning anticipates limited access to ports and emphasizes over-the-shore logistics using modular floating piers, temporary ramps, and ship-to-shore transfer systems. Fixed, time-dependent, and difficult to defend, these assets are highly vulnerable. Persistent USV harassment can delay throughput precisely when sustainment becomes critical.

Figure 30. Reuters. A modular floating pier enables temporary shore unloading without a functioning port.[94]

Secondary Priority Targets

Escort Frigates

Frigates constitute the numerically dominant and operationally most exposed component of the escort layer. Within the PLAN, multi-mission frigates such as the Type 054A are optimized for sustained close escort of high-value platforms, including amphibious ships, auxiliary logistics vessels, and civilian sealift operating under military–civil fusion arrangements. Their importance derives from their sensor suite and aviation assets, particularly ship-borne helicopters used for surface search, screening, and intercepting small surface threats.

A relevant case is the Russian frigate *Admiral Makarov* (Project 11356R), where a single USV impact on the starboard aft section reportedly damaged part of the propulsion system. The strike illustrates the typical targeting logic aiming at maneuvering capability, but the ship was not fully stopped, and two of the three USVs involved were not employed due to environmental constraints.[95]

Against more capable and automated Chinese warships, achieving a similar effect would likely require coordinated swarms and distributed pressure to saturate sensors, weapons, and crew attention. Once defensive systems are engaged, attacks would concentrate on vulnerable areas, such as the aft section, to produce a mobility kill, thus mirroring the conceptual approach demonstrated in the BDK *Caesar Kunikov* and *Ivanovets* cases.

Non-Priority Targets

Small and High-Speed Landing Craft

Smaller landing craft and fast assault vessels play a complementary role, enabling rapid movement of troops and equipment from ship to shore, particularly in later stages of an amphibious operation. While numerically significant, their individual contribution to operational outcomes is limited.

These platforms are most vulnerable when stationary or constrained, during staging, assembly, or unloading near shore. Ukrainian strikes against Serna- and Akula-class craft demonstrated that single USV attacks were sufficient to neutralize such vessels in port.[96] In transit, however, two factors raise the engagement threshold for USVs. First, smaller vessels benefit from greater maneuverability, which complicates targeting. Second, Chinese LCAC-class hovercraft, specifically the Type 726, can reach speeds up to 80 kn, well above typical USV speeds (SeaBaby ~48 kn; MAGURA ~42 kn).[97]

Other Surface Vessels

Patrol vessels, corvettes, and missile craft can be targeted under favorable conditions, as demonstrated in the Black Sea. However, their speed, replaceability, and limited role in sustainment reduce their campaign-level impact. Ukrainian experience shows that attacks on patrol vessels and missile craft required sustained ISR, careful planning, and multiple coordinated strikes, highlighting the inherent difficulty of engaging small, agile surface combatants.

94. Martell et al., "China's shadow navy trains to take Taiwan."
95. Snake Island Institute, The Black Sea's Asymmetric Blueprint.
96. B., V., "ГУР підтвердило ураження російських десантних катерів проєктів "Акула" та "Серна" [GUR confirms hit on Russian landing craft projects "Akula" and "Serna"]," Militarnyi, November 10, 2023, militarnyi.com
97. Weapons Parade, "TYPE 726 LCAC class hovercraft," n.d., weaponsparade.com
Kyrylo Samoylenko, "MAGURA V5: український морський дрон, що переписує історію війни на морі [MAGURA V5: Ukrainian naval drone that rewrites the history of warfare at sea]," АрміяInform, March 17, 2025, armyinform.com.ua

In a Taiwan scenario, such vessels would be forced to operate in close proximity to high-value amphibious and logistics transports, reducing freedom of maneuver and increasing predictability. Even so, they remain opportunistic or pressure targets, not the main effort of a USV strategy.

Beyond Surface Targets

In the Black Sea, maritime drones were used against more than surface vessels alone. As Russian forces relied on helicopters and aircraft to counter USVs, Ukrainian operators introduced maritime drones armed to engage low-flying aerial targets. This led to the destruction of at least one Mi-8 helicopter and two Su-30 fighter aircraft, and increased the cost and risk of employing aviation for reconnaissance and maritime security.[98]

Ukrainian operations have also demonstrated the potential of unmanned maritime systems against undersea platforms.

On 15 December 2025, underwater drones known as Sub Sea Baby detonated a Russian Project 636.3 (Kilo-class) submarine in the port of Novorossiysk, causing critical damage and effectively removing the vessel from service.The submarine had relocated there after earlier Ukrainian surface drone operations made basing in Sevastopol increasingly unsafe.[99]

These cases remain exceptional and do not redefine aircraft or submarines as primary targets of maritime drone operations. They nonetheless indicate that the scope of potential targets can broaden as unmanned systems adapt to countermeasures. In a Taiwan contingency, this suggests that certain PLAN assets operating in close proximity to maritime drone activity, including naval aviation operating over littoral waters and diesel-electric submarines such as the Type 039A/B during port access or basing, may face increased exposure under predictable operating conditions.

Temporal Windows: When USVs Have Maximum Leverage

Phases of Invasion Where USVs Have Maximum Leverage

Maritime Blockade / Gray-Zone Operations

Before a potential amphibious assault, China might seek to pressure or isolate Taiwan through a mix of maritime and airspace restrictions. These measures would not have to follow a clear sequence and could be combined or adjusted as political conditions and external reactions evolve.[100]

At earlier stages, such as a gray-zone embargo or a limited quarantine, Chinese actions would likely be presented as regulatory or law-enforcement measures. Under these conditions, the room for using attack USVs is narrow. Direct attacks on Chinese ships would carry obvious escalation risks, leaving USVs mainly useful for observation tasks, such as tracking patrol behavior, inspection activity, and other actions that shape access to the island.

If China were to move toward a de facto maritime blockade, the role of USVs would become more practical, even if still limited in scope. Once interdiction becomes routine, the blockade shifts to day-to-day enforcement, relying on continuous patrols, rotations, and logistical support. In this setting, USVs could be used to place steady pressure on blockading forces, especially auxiliary, coast guard, and gray-zone vessels that sustain presence and coverage. Already prior to a full blockade, USVs would serve the ROC as reconnaissance assets and for deterrence purposes. Even occasional, diversionary-style attacks or a credible risk of them, could disrupt patrol plans, force sudden changes of course, and require Chinese forces to reshuffle escorts and operating patterns. The unpredictability and uncertainty about the affiliation of the drone amplifies the psychological effect, increases caution and slows decision-making.

98. Snake Island Institute, The Black Sea's Asymmetric Blueprint.
99. Sebastien Roblin, "In First Attack By UUV, Ukraine's 'Sub Sea Baby' Drone Blasted Russian Black Sea Kilo Submarine," Inside Unmanned Systems, December 16, 2025, insideunmannedsystems.com
100. Global Guardian, "Will China blockade Taiwan? Intel analysts examine 4 scenarios," May 24, 2024, globalguardian.com

In a more escalatory situation approaching a kinetic blockade, where force is used openly, USVs could be employed more aggressively. They might be used against Chinese naval vessels to open short-lived gaps in enforcement or to make sustained isolation harder and more resource-intensive over time.

Initial Sustainment

Once the initial assault wave is ashore, the campaign enters a phase in which success depends on the continuous functioning of a small and fragile logistics system. PLA doctrinal and analytical sources consistently identify initial sustainment as one of the most difficult and least mature components of a Taiwan operation. Unlike the assault phase, redundancy is limited, timelines are compressed, and available logistics assets are finite.

In this phase, logistics would rely almost entirely on shore-to-shore and over-the-shore delivery. Fuel, ammunition, medical supplies, and reinforcements would be moved directly onto beaches or through improvised offload points. The first-echelon force is expected to be supported mainly by amphibious landing ships, air-cushion vehicles such as LCACs and Zubr-class craft, medium and small landing craft, and a limited number of auxiliary vessels. Civilian fishing boats, converted RO/RO ships, and semisubmersible transport vessels may supplement this effort. Temporary solutions such as floating piers, stern ramps, mobile cranes, and sea-to-shore fuel pipelines are intended to compensate for the absence of functioning ports, but all require time to deploy, uninterrupted access, and continuous protection.

This logistics model is inherently fragile. Throughput depends on maintaining a strict operational rhythm in which ships arrive in sequence, unload within narrow windows, and clear approaches for subsequent waves. Any interruption, whether caused by weather, mine threats, escort shortages, or precautionary pauses, can rapidly create backlogs at sea and shortages ashore.

PLA analyses emphasize that accelerated landing schedules compress logistics timelines, while high-tempo combat sharply increases demand for fuel, ammunition, maintenance, and casualty evacuation at precisely the moment when delivery systems are least mature.

Civilian shipping becomes relevant primarily after ports are seized or partially restored. Prior to that, civilian RO/RO vessels, semisubmersibles, and container ships require extensive modification, specialized unloading equipment, and trained personnel to function in a contested littoral environment. PLA sources acknowledge persistent shortfalls in these areas, including insufficient reserve specialists and limited experience conducting large-scale, multi-mission logistics exercises under realistic combat conditions.

For unmanned surface vessels, this phase offers far greater leverage than the initial assault. Sustainment fails not because individual ships are sunk, but because the logistics system loses its ability to maintain tempo under continuous pressure. Persistent disruption that forces delays, rerouting, repeated clearance operations, and heightened force-protection measures can reduce effective throughput faster than the PLA can compensate through mass or redundancy. This undermines the ability to build and sustain beachheads, delays the seizure and restoration of ports with higher throughput capacity, and slows the transition from an improvised landing operation to a port-centric campaign.

Table 5. Illustrative Timing and Capacity Constraints of the PLA fleet (Based on RAND assumptions).[101]

PARAMETER	RAND ESTIMATE	OPERATIONAL IMPLICATION
Average cross-strait distance	~120 nautical miles	Long exposure windows during transit
Average transit speed	~15 knots	Each crossing requires ~8 hours
Beach unloading time per ship	~1 hour	Landing-site congestion
Reload / refuel / maintenance cycle	~12 hours	Slow sortie regeneration
Maximum ships unloading simultaneously	~20 ships	Caps throughput
Typical amphibious column size	~10 ships	Packetized logistics flow
Time spacing between ships	~24 minutes	Predictable movement patterns
Escorts per amphibious column	~5–20 combatants	Escort-limited capacity

Port-Centric Sustainment

If China manages to capture one or more ports, the campaign enters its most logistics-intensive phase. Ports enable the delivery of heavy equipment, armor, ammunition, and fuel at volumes impossible to sustain through direct beach delivery alone, making them essential for offensive operations beyond the coastal lodgments.

At the same time, ships operating in and around ports are highly vulnerable. Traffic is constrained, vessels are often stationary or moving slowly, and defensive coverage is difficult to maintain continuously. Experience from the Black Sea shows that even well-guarded ports struggle to protect shipping against persistent unmanned threats focused on disruption rather than destruction.

This phase is also likely to involve expanded reliance on civilian shipping. While this increases transport capacity, it also introduces large numbers of low-resilience platforms with limited self-defense, predictable operating patterns, and high dependence on escorts and port infrastructure.

Sustained USV pressure in this phase is aimed not at ship destruction, but at forcing the fleet to operate inefficiently. By extending transit times, disrupting port cycles, and diverting combat power to continuous force protection, USVs can impose cumulative exhaustion on the fleet and turn numerical transport capacity into an operational liability.

Phases with Limited USV Influence

Initial Amphibious Assault

The delivery of the first assault wave is widely assessed as critical to the overall success of a cross-strait operation, but it offers limited leverage for the effective use of unmanned surface vessels. At this stage, success is defined less by the survival of individual ships than by whether a minimum package of combat capability, including command elements, infantry, fires, and access for follow-on forces, can be landed within a narrow time window. PLA amphibious forces are structured to prioritize this outcome through mass, redundancy, and overlapping delivery methods.

101. Heginbotham et al., U.S.–China Military Scorecard.

Although the PLA Navy operates a relatively small number of high-value amphibious combatants (four Type 075 LHDs and eight Type 071 LPDs) the initial assault would likely be distributed across a much larger and more diverse set of platforms. This includes more than two dozen Type 072 heavy landing ships, over a dozen Type 073 medium landing ships, roughly thirty Type 074 landing craft operated by naval and ground forces, as well as high-speed assets such as Zubr-class hovercraft and Type 726/726A LCACs. This force mix allows risk to be dispersed across platforms, supports landings at multiple locations and time intervals, and enables losses to be absorbed without necessarily reducing the landed force below the threshold required to establish an initial foothold.

The landing itself is expected to occur within a highly compressed time window, intended to place sufficient forces ashore before defenders can concentrate fires. To meaningfully change the outcome, USVs would need to disrupt a large share of this distributed fleet almost simultaneously and under conditions of dense escort, surveillance, and electronic warfare. More limited disruption, such as damaging individual vessels or delaying isolated elements, may impose costs but is unlikely to prevent enough combat units from reaching shore within the planned timeframe. As a result, while USVs can create friction during the assault wave, their operational leverage at this stage is lower than in later phases that depend on sustained maritime access and logistics.

At this stage, USVs are best understood as one component of a broader “porcupine strategy,” contributing to a layered defensive environment alongside mines, shore-based anti-ship missiles, coastal artillery, and other systems.

Operations Near Mainland China

Operations by Taiwanese USVs against targets on the Chinese mainland would face significant practical and political constraints. Beyond escalation risks, such actions would require unmanned vessels to cross the Taiwan Strait, operating over extended distances and under variable sea and weather conditions, while passing through areas subject to dense surveillance and patrol activity. These factors narrow the conditions under which such operations could be attempted and limit their reliability. At the same time, Chinese amphibious forces are most vulnerable while concentrated in ports or operating close to the coast during the preparation and staging phase of an invasion. In this context, USVs could be used to disrupt loading schedules, delay departures, or create localized security concerns. Taiwan’s control of several islands closer to the mainland slightly alters the geometry of the problem by reducing transit distances, but it does not remove the underlying operational challenges. Overall, the use of USVs in this role would represent a narrowly applicable, supporting option aimed at complicating Chinese preparations rather than a central line of effort.

Conclusion

We argue that unmanned surface vehicles can provide Taiwan a significant advantage in its defense by exploiting unique features of the environment and PLA invasion vulnerabilities. Their relevance emerges precisely from structural weaknesses exposed in existing Taiwanese defense models.

Taiwan's Structural Weaknesses:

- Extreme time compression
- Early degradation of conventional forces
- Isolation under blockade
- Heavy reliance on uncertain external intervention

While powerful elements of a defensive strategy, USVs should not be understood as a substitute for Taiwan's conventional naval or air forces, nor as a decisive weapon capable of independently defeating a PLA invasion. ***Most importantly, implementing this strategy requires Taiwan to develop solutions for two open challenges: industrial support and launch and sustainment options for a USV strategy.***

The Ukrainian maritime campaign proves that attritable unmanned systems can impose disproportionate costs on a superior naval force. While the Taiwan Strait presents harsher conditions, these do not negate the Ukrainian model but transform it. While prevailing debate often views the Strait's rough weather only as a limitation for drones, these conditions also provide critical cover. Given the sophistication of Chinese ISR and automated ship-defense systems, heavy seas and poor visibility may be the only viable way for a USV to approach a high-value target without being detected and engaged at long range. Furthermore, the intricate geography of the Strait becomes a trap for the aggressor, as it forces the PLAN to concentrate in predictable landing corridors, creating ideal focal points for the mass employment of USVs. In this context, environmental difficulty is as much an operational opportunity as it is a technical challenge.

Given the PLAN's technologically advanced defense systems, which are automated, multi-layered, and increasingly refined by lessons from the war in Ukraine, the most critical takeaway from the Black Sea is the necessity of mass. Coordinated, large-scale attacks, integrated with other joint capabilities, are required to saturate these defenses. In such operations, the objective is to overwhelm the adversary's engagement capacity. This implies a high rate of attrition, where a significant portion, potentially more than half, of the attacking USV wave may be destroyed before reaching the target.

Three lessons from Ukraine:

1. Mass is the decisive variable

Coordinated, large-scale attacks integrated with joint capabilities are required to saturate automated, multi-layered PLAN defenses. Attrition of 50%+ per wave must be designed into the concept, not treated as a failure mode.

2. Conditions create cover

Heavy seas and poor visibility in the Taiwan Strait, often viewed as limitations, may actually present viable approach windows against advanced Chinese ISR and automated ship-defense systems.

3. Adaptation speed is a force multiplier

Ukraine consistently out-developed Russian countermeasures within months at comparably low cost, proving that a modular, upgradeable design philosophy over fixed, exquisite platforms is a virtue in asymmetric warfare.

Ultimately, Taiwan's main challenge lies not in the tactical domain, but in the industrial and logistical one. Given the island's geography and the adversary's reliance on a rapid operation, Taiwan's survival will depend on its ability to scale production and sustain a high tempo of attacks under isolation. This requires a pre-war stockpile of thousands of platforms available for immediate use at the outset of hostilities. Current procurement plans project significant deliveries in the late 2020s, with mass stockpiles envisioned around 2030 at the earliest.

However, even if these production goals are met, a secondary and equally difficult challenge emerges in maintenance and storage. Thousands of USVs cannot simply be kept in a few locations; they require a vast, distributed, and hardened infrastructure. This storage must be both protected from pre-emptive strikes and positioned for rapid access.

The final and most difficult part of the problem is the launch itself. Deploying a sufficient number of drones to saturate a target takes time, the entire process remains exposed to Chinese ISR and kinetic strikes. Consequently, Taiwan must develop ways to move, prepare, and launch these systems while under constant observation and fire.

Production facilities, storage depots, transport routes, and launch sites all form part of the same vulnerable system. Developing this integrated infrastructure is a strategic task of the highest order. Taiwan cannot solve this problem quickly or during a crisis. It requires long-term planning, massive investment, and physical protection. Without this industrial and logistical foundation, the entire concept of unmanned asymmetric warfare will not hold under wartime pressure.

Two open challenges:

1. Industrial scaling

Taiwan's survival depends on its ability to scale production and sustain a high tempo of attacks under isolation. This requires a pre-war stockpile of thousands of platforms available for immediate use. Current plans project mass stockpiles around 2030 at the earliest, a window that may not align with the threat timeline.

2. Launch and sustainment

Thousands of USVs cannot be stored in a few locations. They require vast, distributed, and hardened infrastructure, protected from pre-emptive strikes and positioned for rapid access. Deploying enough drones to saturate a defended target within a narrow time window, under persistent Chinese ISR and kinetic pressure, remains a problem.

The operational logic of the USV remains valid; it provides scalable pressure on enemy operations. In a Taiwan contingency, the primary operational contribution of USVs is not in sinking frontline combatants or preventing the initial landing outright, but in degrading tempo. By targeting amphibious lift, logistics vessels, semi-fixed maritime infrastructure, and exposed escort elements, USVs can interfere with sequencing, timing, and sustainment, the very mechanisms that determine whether a landing force can consolidate and transition from a vulnerable beachhead to a sustainable campaign.

Across different stages of a potential conflict, USVs can impose pressure on Chinese operations in ways that matter most. In the early blockade phase, diversionary-style attacks can slow patrols, force escorts to be redeployed, and compel Chinese units to adjust their operations. The greatest impact comes during initial sustainment and port-based logistics, when the flow of supplies, fuel, and reinforcements is most fragile. By interfering with ship arrivals, unloading, and resupply, USVs reduce the efficiency of the logistics system, causing delays and shortages onshore. Furthermore, they force the adversary to devote resources to defend their logistics system, imposing additional costs onto them. In a campaign with tight timelines and limited margins, these delays can determine whether the landing force can be sustained or fails.

Therefore, the operational concept outlined in this report rests on a simple but demanding premise:

USVs matter not because they are revolutionary technologies, but because they are scalable instruments of disruption in a campaign where time, logistics, and sequencing determine outcomes. Whether Taiwan can translate this logic into credible deterrence depends less on tactical ingenuity than on its ability to industrialize attrition, absorb losses, and sustain pressure under the most constrained conditions imaginable.

With thanks to our partner units and all of those who contributed to Ukraine's victory on the Black Sea, many of whom cannot be named at this time.

This report is grounded in their operational experience and shaped through interviews, field insights, candid feedback, and professional expertise.

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