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Changing Tides in Maritime Warfare

Closing the Reporting Gap on Uncrewed Maritime Systems in the United Nations Register of Conventional Arms

ANABEL GARCÍA GARCÍA · SARAH GRAND-CLÉMENT · PAUL HOLTOM

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About UNIDIR

The United Nations Institute for Disarmament Research (UNIDIR) – an autonomous institute within the United Nations – conducts research on disarmament and security. UNIDIR is based in Geneva, Switzerland, the centre for bilateral and multilateral disarmament and non-proliferation negotiations, and home of the Conference on Disarmament. The Institute explores current issues pertaining to a variety of existing and future armaments, as well as global diplomacy and local tensions and conflicts. Working with researchers, diplomats, government officials, NGOs and other institutions since 1980, UNIDIR acts as a bridge between the research community and Governments. UNIDIR activities are funded by contributions from Governments and donor foundations.

Note

Authors

Anabel García García is a Graduate Professional in the Exploratory Research Cell of the UNIDIR Conventional Arms and Ammunition Programme.

Sarah Grand-Clément is a Researcher in the Conventional Arms and Ammunition Programme and the Security and Technology Programme at UNIDIR.

Paul Holtom is the Head of the Conventional Arms and Ammunition Programme at UNIDIR.

Acronyms & Abbreviations

AI	Artificial intelligence
ASW	Anti-submarine warfare
ATT	Arms Trade Treaty
GGE	Group of Governmental Experts
ISR	Intelligence, surveillance and reconnaissance
UAS	Uncrewed aerial system
UMS	Uncrewed maritime system
XLUMS	Extra-large UMS

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Executive Summary

Surface and underwater uncrewed maritime systems (UMS) are gaining importance in the maritime domain due to their force multiplier effect and their ability to enhance naval force projection. UNIDIR research has identified 60 UMS development programmes in 17 countries. These vessels can be used to undertake intelligence, surveillance and reconnaissance and anti-submarine warfare, as well as offensive actions. Almost half of the UMS reviewed for this Insight can be armed with light weapons, mines, torpedoes and missiles. The analysis of trends shows a notable increase in incidents involving UMS since 2023. Parallels can therefore be made between trends in UMS and those previously observed in the proliferation of uncrewed aerial systems (UAS). Thus, UMS pose or could pose challenges to international security due to their proliferation, contributing to arms races, illicit use by non-state actors, and risks for civilian infrastructure.

The United Nations Register of Conventional Arms (the Register) could play an important role in enhancing mutual trust and confidence between States if it contained information on international transfers and acquisitions of armed UMS. However, there are challenges for reporting such information on armed UMS. These fall outside the technical description provided by Category VI ("Warships") as their tonnage is well below 500 tonnes and they are generally not equipped to launch missiles or torpedoes with a range of at least 25 kilometres.

This Insight proposes four options for consideration by the Group of Governmental Experts meeting in 2025 to consider the continuing operation and further development of the Register. These options could also be considered by States participating in other multilateral instruments that contribute to increasing transparency in international transfers and acquisitions. Not all of the options presented are mutually exclusive:

1. The Group recommends United Nations Member States indicate in their submissions to the Register whether a vessel is uncrewed, should such systems fulfil the technical characteristics outlined in the Category VI description.
2. The Group recommends reducing the current technical characteristics of Category VI to better match that of armed UMS that pose a threat to international peace and security.
3. The Group recommends a change to the title of Category VI to reflect armed UMS and create a subcategory with specific technical characteristics and functions that differ from the crewed vessels (following the examples set by previous amendments to Categories IV and V on combat aircraft and attack helicopters).
4. The Group recommends the creation of a new category for providing information on international transfers and the acquisition of armed UMS.

1. Introduction

A growing number of States worldwide are developing uncrewed maritime systems (UMS) for military purposes. The United States Navy is reportedly investing $2.2 billion in uncrewed surface systems and $1.9 billion in uncrewed underwater systems in the period 2021–2025.[1] Beyond growing investments in UMS programmes, there has also been an increase in offensive military actions using UMS in recent years. In 2019, there was one recorded offensive use of a UMS to conduct an attack. In 2024, UNIDIR research uncovered evidence of at least 22 attacks (see Box 1 on the methodology). Indeed, the recent use of UMS in the context of the Russian Federation's full-scale invasion of Ukraine has demonstrated their military relevance, complementing traditional naval warfare approaches using warships and anti-ship missiles.[2]

UMS encompass two main types of vessels:

- surface systems, that operate above the surface or only slightly below; and
- underwater systems, that have the capability to function underwater at various depths, depending on the type of system and its intended use of operation.

UMS can fulfil a variety of tasks, both above and below the surface. These can range from information gathering and defensive actions (e.g., countering sea mines) to undertaking offensive naval operations. The key characteristics of UMS are the absence of human personnel on board and the ability to either operate autonomously or be remotely piloted.

With UMS increasingly being developed and used for offensive purposes, a better understanding of their role in national defence and security strategies and military doctrine is becoming critical. Therefore, increasing information on their international transfer and acquisition by States, as well as their use around the globe, is of growing importance for international peace and security. The United Nations Register of Conventional Arms (hereafter, the Register) was established because it was hoped that global transparency in armaments could prevent misperceptions that would lead to arms races and the diversion of resources to military spending, and would thereby contribute to peace and stability.[3] Given the emerging threat to international peace and security posed by the proliferation of UMS and their use in attacks, the Register could play an important role in contributing to mutual trust and confidence building between States if it were to contain information on international transfers and acquisition of armed UMS.

This Insight provides an overview of current trends in the use and development of UMS. It examines the current relevance and utility of the Register and provides suggestions on how to overcome potential gaps. The findings of this analysis could be of relevance to members of the diplomatic and policy communities working on conventional arms and new and emerging technologies. Likewise, it could inform arms control experts and practitioners engaged in fostering transparency and accountability in the global arms trade.

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1 Jin-Yun Wang and Wei Ke, "Development Plan of Unmanned System and Development Status of UUV Technology in Foreign Countries", *Journal of Robotics and Control*, vol. 3, no. 2 (2022): 187–95, https://doi.org/10.18196/jrc.v3i2.10201.

2 Lyle Goldstein and Nathan Waechter, "What Chinese Navy Planners Are Learning from Ukraine's Use of Unmanned Surface Vessels", RAND, 4 April 2024, https://www.rand.org/pubs/commentary/2024/04/what-chinese-navy-planners-are-learning-from-ukraines.html.

3 United Nations, General Assembly, Resolution 46/36 L, "Transparency in Armaments", 9 Dec. 1991, https://docs.un.org/A/RES/46/36.

BOX 1.

Methodology overview

The data used for this Insight was collected by reviewing open-source information made available during 2019–2024 on the development of UMS and on trends in the use of these vessels.

Regarding the development of UMS by countries or companies, information was collated on 60 systems intended for military use, spanning 17 countries. This includes countries around the world, although a majority are in Asia, Europe and North America (see Figure 1). This information is not aimed to be exhaustive.

Regarding trends in use of armed UMS, the focus was on incidents where armed UMS undertook offensive action, regardless of the target. A total of 43 verified attacks were identified. All but two of the incidents took place in the Black Sea or the Red Sea. The other two took place in the Arabian Sea and the Mediterranean Sea.

FIGURE 1.

Locations of UMS development programmes, 2019–2024

Source: UNIDIR analysis. This map is for illustrative purposes only. The boundaries and designations shown do not imply official endorsement by UNIDIR or the United Nations.

While every effort was taken to validate and cross-reference the data, two main limitations should be noted. First, information on attacks was often fragmented and at times lacked sufficient information to ascertain armed UMS use. When information could not be verified, it was not used for this report. Second, international transfers and the acquisition of armed UMS are not systematically reported – or reported at all – by States under international transparency and confidence-building mechanisms such as the Register or the Arms Trade Treaty (ATT). This makes structured and robust data about UMS difficult to identify based on open-source information. As a result, the available information is incomplete, and gaps in knowledge and understanding of these vessels, their capabilities and their use cannot be ruled out.

This Insight is structured as follows: Section 2 examines the capabilities and technical characteristics of current UMS, as well as recent trends in use. Section 3 then introduces the Register and assesses its current relevance and utility, with a focus on identifying potential gaps and areas for improvement in relation to armed UMS. Section 4 follows with suggestions on how to overcome shortcomings in the Register's approach to including information on armed UMS, while Section 5 concludes the Insight.

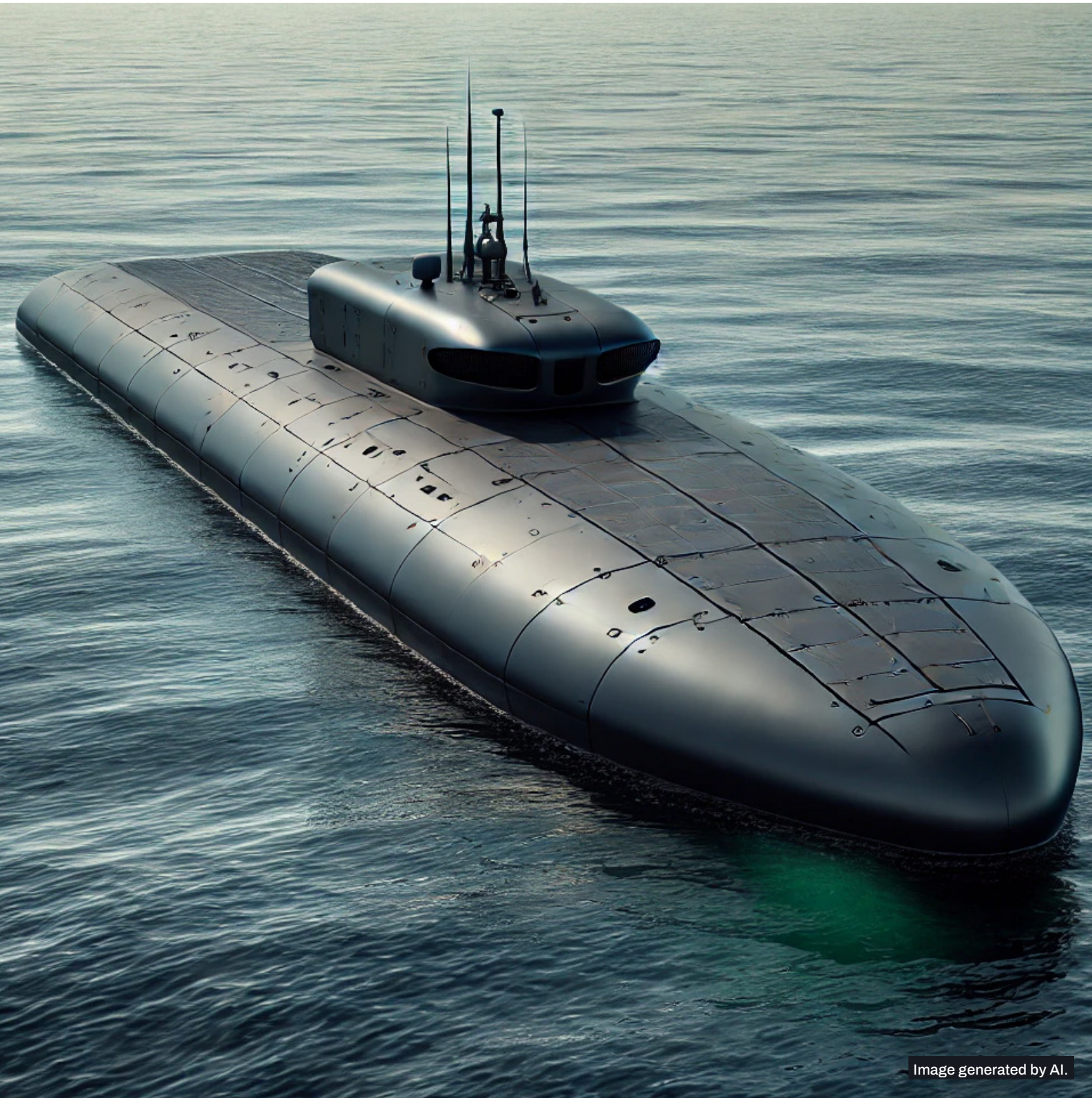

Image generated by AI.

2. UMS in the 21st Century: Recent Developments and Current Capabilities

The increase in the capabilities of UMS in recent years can be attributed to technological advancements, namely the use of artificial intelligence (AI) for navigation and mission planning, and increased efforts to enhance the utility of UMS for naval operations.[4] This section provides an overview of the trends in capabilities, technical characteristics, and use, based on data gathered by UNIDIR for the period 2019–2024.

2.1. Examining the Wide Range of UMS

UMS can be tethered,[5] remotely operated or autonomous. The size of a system, how it is powered and whether it operates on the surface or underwater will dictate many of its capabilities and limitations. For example, underwater systems face specific challenges regarding communications and navigation, meaning that these systems will generally be programmed to have more autonomy, unless they are tethered.[6] Some surface UMS are also capable of loitering semi-submerged or just below the surface.[7]

The key characteristic differentiating UMS – both surface and underwater – from crewed vessels is the total absence of personnel on board.[8] While characteristics such as size, weight, range or diving depth will be driven by the type of tasks a UMS is meant to undertake and the amount and type of payload it will be expected to have, UMS will generally be smaller and lighter than their crewed equivalent and can thus have greater manoeuvrability than crewed vessels.[9] Additionally, the lack of a crew on board the vessel removes limits on the length of operational use (other than those related to technical issues) and on types of task, with more "dull, dangerous and dirty"[10] tasks enabled (further discussed in Section 2.1.3).

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4 Arif Wibisono, Md. Jalil Piran, Hyoung-Kyu Song and Byung Moo Lee, "A Survey on Unmanned Underwater Vehicles: Challenges, Enabling Technologies, and Future Research Directions", *Sensors*, vol. 23, no. 17 (2023): 7321, https://doi.org/10.3390/s23177321.

5 A tethered UMS means that there is a physical connection between the vehicle and the remote-control system.

6 Theò Bajon and Sarah Grand-Clément, "Uncrewed Maritime Systems: A Primer", UNIDIR, 2022, https://doi.org/10.37559/CAAP/22/ERC/13; Jim Romeo, "Unmanned Vehicle Systems: Ready for Takeoff", *Military + Aerospace Electronics*, October 2023, https://www.militaryaerospace.com/uncrewed/article/14298866/unmanned-underwater-vehicles-special-report.

7 Paolo Valpolini, "IDEF 2023 – Havelsan Çaka s-Kusv, an Invisible Threat for Naval Ships", *European Defence Review Magazine*, 29 July 2023, https://www.edrmagazine.eu/havelsan-caka-s-kusv-an-invisible-threat-for-naval-ships.

8 Andrei Bursuc, Cristian Munteanu and Simona Rus, "Overview on Sea Drones Evolution and Their Use in Modern Warfare", *Land Forces Academy Review*, vol. 29, no. 2 (2024): 195–209, https://doi.org/10.2478/raft-2024-0021.

9 Romeo, "Unmanned Vehicle Systems".

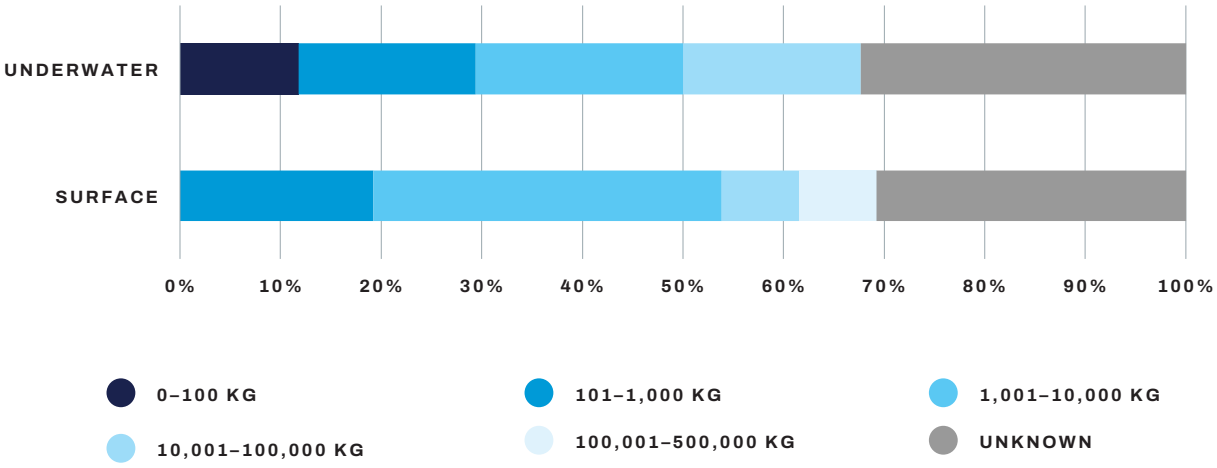
10 This terminology refers to tasks which are tedious, repetitive or dangerous to humans.

2.1.1. Technical Characteristics

UMS come in a wide variety of sizes, ranging from small micro-UMS[11] to so-called Extra Large UMS (XLUMS).[12] Weight constitutes one of the key characteristics of UMS and is usually expressed as a vessel's "displacement".[13] As shown in Figure 2, most of the vessels were found to have a standard displacement of 10 metric tonnes (10,000 kilogrammes) or less. None of the vessels, where data on weight was provided, were found to be over 500 metric tonnes (500,000 kg).

FIGURE 2.

UMS standard displacement, by operational environment, 2019–2024



Source: UNIDIR analysis

Smaller UMS, especially underwater vessels, can be harder to detect on radar than crewed vessels, which presents unique challenges in detection and categorization by other vessels.[14] Characteristics that enable this include smaller noise generation, smaller size and even specific design features, known as biomimicry, whereby a UMS is designed to mimic sea animals.[15]

Surface UMS are usually faster than underwater UMS. For both, the size of the UMS and

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11 See for example "Power in Numbers: Unleashing Swarms of Micro-Autonomous Underwater Vehicles to Gather-Intelligence at Sea", Arkeocean, 1 April 2024, https://arkeocean.com/power-in-numbers-unleashing-swarms-of-micro-autonomous-underwater-vehicles-to-gather-intelligence-at-sea/.

12 Ronald O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress* (Washington, DC: Congressional Research Service, 2024), https://sgp.fas.org/crs/weapons/R45757.pdf.

13 Displacement refers to "the weight of the water that a ship displaces when it is floating, which is equal to the weight of the ship". Specifically, the Register refers to "standard displacement", which encompasses the weight of the vessel itself plus the payload it carries, and is the approach used when assessing the displacement of the UMS reviewed. See PredictWind, "Displacement", n.d., https://www.predictwind.com/glossary/d/displacement.

14 Wahab Khawaja et al., "Threats from and Countermeasures for Unmanned Aerial and Underwater Vehicles", *Sensors*, vol. 22, no. 10 (2022): 3896, https://doi.org/10.3390/s22103896.

15 Wendy Tang, "Chinese Military's Robo-Shark Drone to Prey on Submarines", *The Times*, 15 July 2021, https://www.thetimes.com/article/chinese-militarys-robo-shark-drone-to-prey-on-submarines-t0dg9fx2m?region=global; Khawaja et al., "Threats from and Countermeasures for Unmanned Aerial and Underwater Vehicles".

its intended use determine the vessel's operational and maximum speed. While some underwater UMS can travel at speeds of up to 15 knots (27 kilometres/hour), many surface vessels reach maximum speeds of over 40 knots (74 km/h). In some instances, uncrewed surface vessels have been reported to reach speeds of over 60 knots (111 km/h).[16] These speeds represent the upper speed categories; vessels would generally operate at lower speeds, such as to ensure longer endurance or because their mission does not require using such speed.

The variance of speed is greater for crewed vessels than it is for UMS. The average maximum speed of crewed naval vessels varies between 10–35 knots (19–65 km/h), with some vessels having a maximum speed of over 50 knots (93 km/h) in calm waters.[17] In comparison, crewed submarines have a typical maximum speed of around 20–30 knots (37–56 km/h), with nuclear-powered submarines being generally faster than diesel-electric submarines.[18]

UMS are diverse in terms of their range, depths of operation and endurance. As with speed, the maximum range of a vessel is dictated by various operational and technical aspects, particularly its payload. Some of the UMS reviewed can cover distances of over 540 nautical miles (1,000 km). Likewise, underwater UMS differ greatly from each other regarding their depths of operation. Seventy-two per cent of underwater UMS reviewed for this analysis operate at depths between 200 metres and 4,000 m. However, some UMS have been reported to dive to depths greater than 4,000 m.[19] While some UMS are designed to carry out missions over the course of several hours, others can loiter for days, weeks or months in low-energy mode.[20]

2.1.2. Weaponization

Almost half of the UMS analysed for this report are, or could be, equipped with conventional weapons, compared to only 7 per cent that do not have or cannot be equipped with weapons. It was not possible to determine if the remaining vessels are or could be armed. Differences emerge when examining surface and underwater UMS separately. The majority (62 per cent) of surface UMS were described as being weaponized (see Figure 3). Less information was available regarding underwater UMS: the weaponization status of 53 per cent of underwater UMS reviewed remains unknown.

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16 "MARTAC Introduces the Devil Ray T18 Smart USV Enhancing Their Portfolio of Multi-Domain Systems Heading for Mass Production in 2025", Naval News, 5 November 2024, https://www.navalnews.com/event-news/euronaval-2024/2024/11/martac-introduces-the-devil-ray-t18-smart-usv-enhancing-their-portfolio-of-multi-domain-systems-heading-for-mass-production-in-2025/.

17 Dennis J. Clark, William M. Ellsworth and John R. Meyer, "The Quest for Speed at Sea", Technical Digest, 2004, https://www.foils.org/wp-content/uploads/2018/01/NSRDC-Quest-for-speed.pdf.

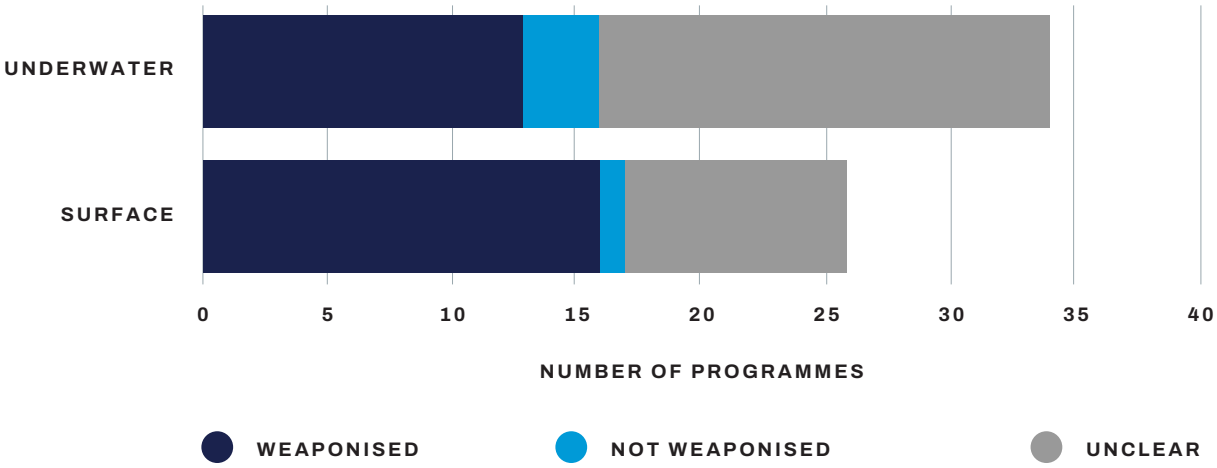
18 Joubert, "Some Aspects of Submarine Design Part 1. Hydrodynamics", DSTO Platforms Sciences Laboratory, 2004, https://apps.dtic.mil/sti/tr/pdf/ADA428039.pdf.

19 Emma Helfrich, "This Is Australia's Testbed For Its Upcoming 'Ghost Shark' Unmanned Combat Submarines", The Warzone, n.d., https://www.twz.com/this-is-australias-new-ghost-shark-unmanned-combat-submarine.

20 Michael N. Schmitt and David S. Goddard, "International Law and the Military Use of Unmanned Maritime Systems", *International Review of the Red Cross*, vol. 98, no. 902 (2016): 567–92, https://doi.org/10.1017/S1816383117000339.

FIGURE 3.

UMS weaponization, by operational environment, 2019–2024



Source: UNIDIR analysis

Overall, it was challenging to obtain detailed information on the specific weapon capabilities of each UMS. Often, weapon capabilities were broadly described as "explosives". In some cases, specific types of weapons (e.g. machine guns, mines, torpedoes and missiles) were disclosed, but without further specifications on type or manufacturer.[21] For instance, in 2023, Russia unveiled a new surface UMS that reportedly has the capability to carry large-calibre machine guns and light missiles, enabling it to counter potential threats such as other uncrewed systems. However, no information was provided on the specific models, technical details, missile range nor manufacturer(s) of the weapons with which this Russian UMS is equipped.[22] In a similar example, the United States has purchased the "Orca" underwater XLUMS developed by Boeing. These are advertised as capable of detecting and laying mines, as well as conducting anti-submarine warfare (ASW) and strike missions, but without further specifics provided.[23]

2.1.3. Capabilities

UMS can assist with or undertake a wide range of tasks in the maritime domain. As shown in Figure 4, the main capabilities that UMS (both developed and under development) are advertised as being able to undertake are intelligence, surveillance and reconnaissance (ISR), ASW, broader offensive activities against targets (such as mine laying), and mine countermeasures (including mine sweeping and detection).

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[21] According to Alex Pape (Head of Sea Insight, Janes), this may be a specific feature of the maritime domain, especially compared to the air domain; UMS can be "customized", whereby customers can select from a range of options for manufacturers to then assess feasibility of implementation.

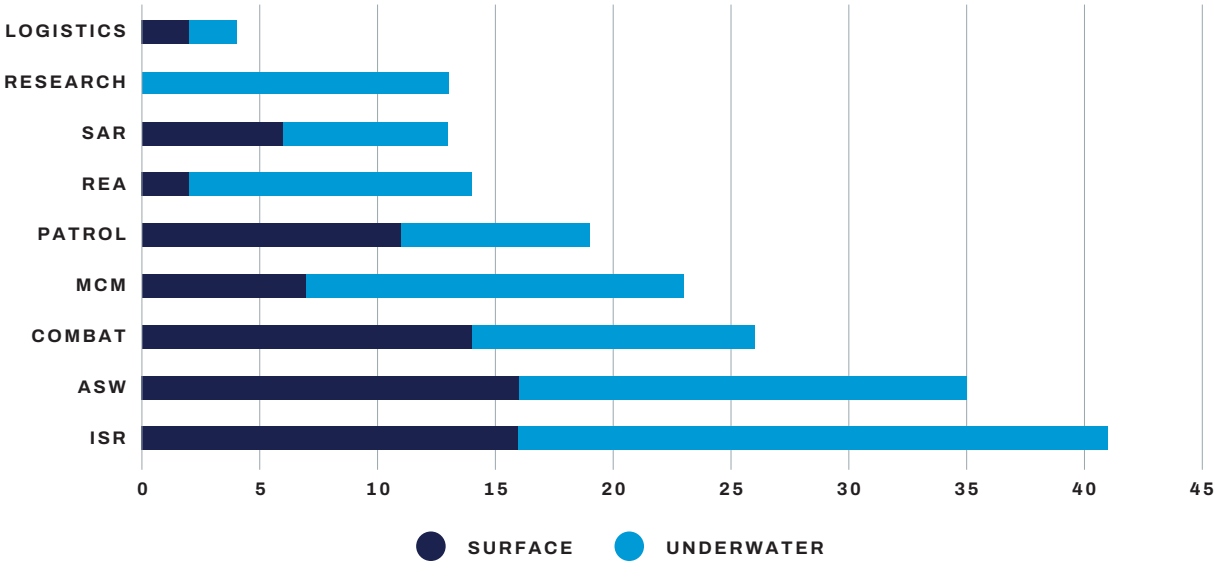
[22] "Army 2023: KMZ from Russia Unveils New Unmanned Surface Vehicle", Global Defence News, n.d., https://armyrecognition.com/news/navy-news/2023/army-2023-kmz-from-russia-unveils-new-unmanned-surface-vehicle.

[23] Boeing, "XLUUV", n.d., https://www.boeing.com/defense/xluuv#overview; "Orca XLUUV, USA", Naval Technology, 2024, https://www.naval-technology.com/projects/orca-xluuv/?cf-view.

The large proportion of UMS with ISR or ASW capabilities can be explained by the uncrewed nature of these maritime vessels, which enables continuous missions for extended periods, and in greater numbers than crewed vessels. ISR becomes more effective as more data is gathered over time, allowing for increasingly precise detection of patterns and anomalies.[24] Similarly, ASW also requires long-term missions to detect and track submarines. Other capabilities include carrying out missions for the search and rescue of persons or vessels; and rapid environmental assessment to gather environmental data for operational purposes. Additionally, UMS have been described as being able to assist with research, logistics (e.g., transportation of supplies), as well as supporting patrol tasks (e.g., by aiding the monitoring of maritime borders).[25]

FIGURE 4.

UMS capabilities, by programme type, 2019–2024



Source: UNIDIR analysis. ASW = Anti-submarine warfare; ISR = Intelligence, surveillance and reconnaissance; MCM = Mine countermeasures; REA = Rapid environmental assessment; SAR = Search and rescue.

[24] Lee Willett, "De-Lousing: The Role of ISR in Enabling Maritime Operations", European Security & Defence, 4 December 2023, https://euro-sd.com/2023/12/articles/34982/de-lousing-the-role-of-isr-in-enabling-maritime-operations/.

[25] Nitin Agarwala, "Integrating UUVs for Naval Applications", *Maritime Technology and Research*, vol. 4, no. 3 (2021), https://doi.org/10.33175/mtr.2022.254470.

Image generated by AI.

2.2. Military versus Civilian UMS Applications and Dual-use Technology

The majority of UMS, particularly XLUMS, are being developed by traditional actors within the defence-technology and -industrial base. However, new manufacturers are emerging, developing vessels of all sizes.[26] This demonstrates the role of commercial companies and civilian or dual-use vessels within the military domains, and offers parallels with trends seen in the development of uncrewed aerial systems (UAS).

This raises important questions on the topic of dual-use technology – that is, technology with dual military and civilian uses – and the increasingly blurred lines between not only civilian and military manufacture of these vessels, but also their application. For example, a civilian UMS can be employed for scientific and exploratory missions.[27] However, in practice, the data that it collects could be used for both scientific research as well as for military purposes, such as submarine warfare.[28]

2.3. Exploring Trends in UMS Use

There was a large rise in attacks using UMS between 2019 and 2024, and especially from 2023 (see Figure 5). This is based on an examination of trends in the use of UMS, focusing on incidents where UMS undertook offensive action (regardless of the target).

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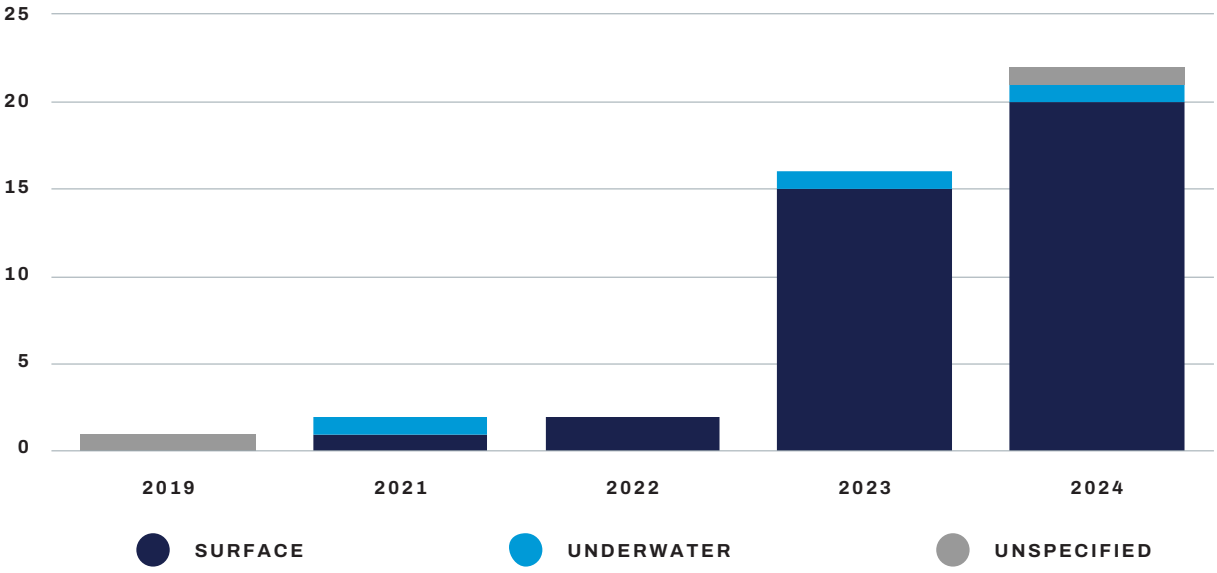
[26] See for example a small start-up developing micro-UMS for ISR purposes in Tim Martin, "French Underwater Drone Swarm Maker Bids to Reshape Maritime Surveillance Missions", Breaking Defense, 7 February 2024, https://breakingdefense.com/2024/02/french-underwater-drone-swarm-maker-bids-to-reshape-maritime-surveillance-missions/; Arkeocean, "Power in Numbers

[27] Sanur Sharma, "Global Developments in Sea-Based Unmanned Crafts", *Manohar Parrikar Institute for Defence Studies and Analyses*, vol. 16, no. 4 (2022): 21–50.

[28] Jeoffrey Maitem, "Armed Forces of the Philippines Investigate Chinese Submarine Drone", Naval News, 3 January 2025, https://www.navalnews.com/naval-news/2025/01/armed-forces-of-the-philippines-investigate-chinese-submarine-drone/; H. I. Sutton, "Underwater Drone Incidents Point to China's Expanding Intelligence Gathering", Royal United Services Institute, 15 January 2021, https://rusi.org/explore-our-research/publications/commentary/underwater-drone-incidents-point-chinas-expanding-intelligence-gathering.

FIGURE 5.

UMS incidents, by type, 2019–2024



Source: UNIDIR analysis. There were no incidents recorded in 2020 which is why it does not appear in the chart.

Of these incidents, the majority (74 per cent) involved armed UMS. This figure is largely explained by the increase in use of single-use (or "kamikaze", "suicide", or "one-way attack") UMS in 2022–2024.[29] Such UMS, which often resemble a kayak or small boat, are equipped with explosives and designed to detonate upon impact. A single-use armed UMS often strikes its target either to sink it immediately or to immobilize it, which results in subsequent attacks being more effective.[30]

For the period under review, the majority of recent UMS developments identified focus on underwater vessels, rather than surface vessels. This contrasts with the fact that nearly all recorded incidents of armed UMS attacks in 2019–2024 were carried out by surface vessels (as shown in Figures 3 and 5). These findings suggest that, while current offensive capabilities are mostly seen in surface UMS, there may be a shift in this trend in the future. Most of the incidents identified in our research took place in either the Black Sea, in the context of the Russian Federation's full-scale invasion of Ukraine or in the Red Sea, in the context of Houthi-led attacks on international shipping off the coast of Yemen (see Box 2 on non-state actor use of UMS). In both cases, armed UMS have not been used in the context of a maritime-based conflict, but of a land-based conflict that has expanded and spilled out to the maritime domain.[31]

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29 Stacie Pettyjohn, 'Evolution Not Revolution Drone Warfare in Russia's 2022 Invasion of Ukraine', Center for a New American Security, February 2024, https://s3.us-east-1.amazonaws.com/files.cnas.org/documents/CNAS-Report-Defense-Ukraine-Drones-Final.pdf.

30 David Axe, "Ukraine's Drone Boats May Have Herded a Russian Warship into Open Water Before Striking", *Forbes*, 6 March 2024, https://www.forbes.com/sites/davidaxe/2024/03/06/ukraines-drone-boats-may-have-herded-a-russian-warship-into-open-water-before-striking/.

31 Joshua Tallis, "The Calm Before the Swarm: Drone Warfare at Sea in the Age of the Missile", War on the Rocks, 31 July 2024, https://warontherocks.com/2024/07/the-calm-before-the-swarm-drone-warfare-at-sea-in-the-age-of-the-missile/.

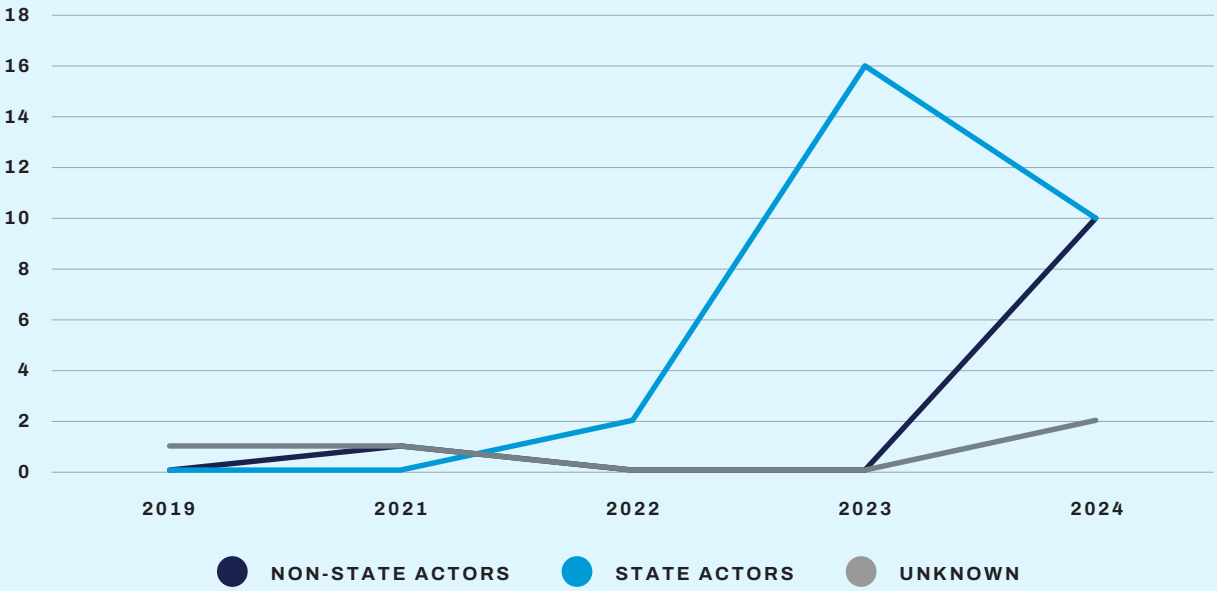
BOX 2.

Non-state actors' use of armed UMS and other illicit activities

While not the focus of the research, armed UMS are used by non-state actors. Non-state actor use of UMS rose dramatically in 2024 (see Figure 6). The UMS used in the recorded instances were typically smaller, improvised vessels, such as converted speedboats or fishing vessels, deployed in asymmetric warfare tactics.[32]

FIGURE 6.

UMS incidents, by actor type, 2019–2024



Source: UNIDIR analysis. There were no incidents recorded in 2020 which is why it does not appear in the chart.

UMS can also be used for a broader range of activities than is examined in the scope of this research. The maritime domain is home to much communications infrastructure, notably subsea communications cables. UMS have been identified as posing a security threat to this infrastructure.[33] While UMS can enhance protection of subsea communications cables,[34] their proliferation could also increase the vulnerability to attack of optical fibre cables and oil pipelines.[35]

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[32] Wolf-Christian Paes and Edward Beales, *Navigating Troubled Waters: The Houthis' Campaign in the Red Sea and the Gulf of Aden* (London: International Institute for Strategic Studies, 2024); "Anatomy of a 'Drone Boat': A Water-Borne Improvised Explosive Device (WBIED) Constructed in Yemen", Frontline Perspective, Conflict Armament Research, 2017, https://www.conflictarm.com/perspectives/anatomy-of-a-drone-boat/; Jonathan Saul and Renee Maltezou, "Houthi Explosive Drone Boat Attacks Escalate Red Sea Danger", Reuters, 3 July 2024, https://www.reuters.com/world/middle-east/houthi-explosive-drone-boat-attacks-escalate-red-sea-danger-2024-07-03/.

[33] Kamali et al., "Red Sea Attacks Disrupt Global Trade"; Willett, "AUVs and ROVs Make Key Contribution to Seabed Warfare

[34] Kristian Bischoff, "The Sea of Drones: How Unmanned Technology is Remaking Naval Warfare", Risk Intelligence, 6 November 2023, https://www.riskintelligence.eu/background-and-guides/the-sea-of-drones-how-unmanned-technology-is-remaking-naval-warfare.

[35] "Australia's Trade and the Threat of Autonomous Uncrewed Underwater Vehicles", RMIT University Centre for Cyber Security Research and Innovation, n.d.

Image generated by AI.

Indeed, a report by the European Parliament's Subcommittee on Security and Defence highlights UMS as a potential security threat to subsea communications cables and infrastructure.[36] UMS could also be used for other illicit activities, such as drug smuggling.[37]

Moreover, the research uncovered several instances of unidentified UMS being found washed ashore in places such as Indonesia, Romania, Türkiye or the United Kingdom, underlining that some UMS are being deployed by unknown actors and for unknown purposes.

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36 Christian Bueger, Tobias Liebetrau and Jonas Franken, *Security Threats to Undersea Communications Cables and Infrastructure – Consequences for the EU* (Brussels: European Parliament, 2022).

37 For example, in July 2022, Spanish police seized three underwater UMS built to smuggle drugs across the sea from Morocco. See Jesús A. Cañas, "Cae Una Banda Que Usaba 'Narcodrones' Ucranios Para Transportar Hachís Por El Estrecho" [Gang Used Ukrainian "Narco-Drones" to Transport Hashish Across the Strait of Gibraltar], *El País*, 28 November 2024, https://elpais.com/espana/2024-11-28/cae-una-banda-que-usaba-narcodrones-ucranios-para-transportar-hachis-por-el-estrecho.html.

2.4. Challenges Posed by UMS to Maritime and International Security

The developments outlined in the previous sections highlight challenges that armed UMS used for offensive purposes can pose to international peace and security in the maritime domain and beyond.

First, increased development and commercialization of UMS has implications for their proliferation, diversion and illicit use. Not only are UMS cheaper to produce than their crewed equivalents,[38] but they can have a significant force-multiplier effect. Examples of use in both the Black Sea and the Red Sea has shown how relatively unsophisticated armed UMS have conducted successful lethal offensive actions against much larger (crewed) vessels, including warships.

Second, the current trends in development and use displays similarities to the patterns already observed in the proliferation of UAS. As with UAS, there has been an increase in the number of producers and users of UMS, ranging from state actors to non-state actors, which can exacerbate the risk of an arms race.[39] UMS and UAS are being produced by large defence companies and commercial producers, as well as being repurposed or manufactured in an improvised manner. There is also an increased interest in the use of UMS to enhance naval force projection. Just as UAS have been used to complement pre-existing aerial capabilities, UMS are increasingly recognized and acquired as a tool complementary to existing maritime systems.[40]

Third, an increase in UMS use not only has implications for military operations, but can also pose a broader maritime security threat. For example, armed UMS have already disrupted important shipping routes, with a negative impact on the global economy.[41] This was highlighted by the shipping crisis in the Red Sea triggered by attacks by the Houthis that included the use of UMS.[42] Effectively protecting maritime shipping routes is critical, given that 90 per cent of international trade of raw materials and manufactured goods is seaborne.[43]

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38 Peter Burt, *The Next Wave: The Use of Military Drones in the World's Oceans* (Shaftesbury: Drone Wars UK, 2024), https://dronewars.net/wp-content/uploads/2024/02/DW-Next-Wave-WEB.pdf.

39 Andrija Ljulj, Vedran Slapničar and Dražen Smiljanić, "Proliferation of Unmanned Aerial and Maritime Vehicles in Military Operations", In Nastia Degiuli et al. (eds.), *Progress in Marine Science and Technology* (Amsterdam: IOS Press, 2024), https://doi.org/10.3233/PMST240043.

40 Burt, *The Next Wave*.

41 Parisa Kamali et al., "Red Sea Attacks Disrupt Global Trade", International Monetary Fund, 7 March 2024, https://www.imf.org/en/Blogs/Articles/2024/03/07/Red-Sea-Attacks-Disrupt-Global-Trade.

42 Lee Willett, "AUVs and ROVs Make Key Contribution to Seabed Warfare", European Security & Defence Technology, 10 April 2024, https://euro-sd.com/2024/04/news/37514/auvs-and-rovs-make-key-contribution-to-seabed-warfare/; Kamali et al., "Red Sea Attacks Disrupt Global Trade".

43 Burt, *The Next Wave*.

3. Challenges in Reporting Armed UMS under the United Nations Register of Conventional Arms

This section introduces the Register and its sixth Category for "Warships". It assesses the potential gaps that exist when it comes to reporting to the Register on international transfers and the acquisition of armed UMS.

3.1. Contextualizing the Register

In 1991, the General Assembly established the Register through resolution 46/36 L to promote global transparency in international arms transfers. It was envisioned that the Register would prevent excessive accumulation of arms and enhance trust and confidence among countries.[44] States are called upon to submit information on their imports and exports of conventional arms on an annual basis, and invited to provide additional background information on their military holdings and procurement of conventional arms through national production. As of the end of 2024, 168 Member States have submitted at least one report to the Register. Therefore, the Register has played an important role in enhancing transparency in international arms transfers and helping to document the authorised international arms trade (see Box 3).[45]

To structure the reports and enhance the understanding of the types of armaments that States trade, the Register established seven categories: (I) battle tanks; (II) armoured combat vehicles; (III) large-calibre artillery systems; (IV) combat aircraft; (V) attack helicopters; (VI) warships; and (VII) missiles and missile launchers.

The scope of the conventional arms covered by the Register and the types of information submitted is not set in stone. The Secretary-General appoints a Group of Governmental Experts (GGE) every three years to consider adjustments to its scope to ensure that the Register reflects technological advances in conventional weapons that are considered a threat to international peace and security.[46]

There have thus been several changes to the scope of the Register over the past 30 years. For example, in 2003, the calibre threshold under Category III "Large-calibre artillery systems" was lowered from 100 millimetres to 75 millimetres, and a subcategory for man-portable air defence systems (MANPADS) was added to Category VII "Missiles and missile launchers".[47] In 2006, building on discussions from 2003, the description of Category VI "Warships" was also amended, lowering the minimum standard displacement from

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[44] United Nations, 46/36 L.

[45] United Nations Register of Conventional Arms, "About", n.d., https://www.unroca.org/about.

[46] United Nations, General Assembly, "Continuing Operation of the United Nations Register of Conventional Arms and Its Further Development", A/77/126, 30 June 2022, https://docs.un.org/A/77/126.

[47] United Nations, General Assembly, "Continuing Operation of the United Nations Register of Conventional Arms and Its Further Development", A/58/274, 13 August 2003, https://docs.un.org/A/58/274.

Image generated by AI.

750 tonnes to 500 tonnes.[48] From 2009, several GGEs considered how to include UAS. Changes were subsequently made to the category titles and descriptions for combat aircraft in 2016[49] and attack helicopters in 2022.[50]

The current description for Warships covered by Category VI is:

Vessels or submarines armed and equipped for military use with a standard displacement of 500 metric tonnes or above, and those with a standard displacement of less than 500 metric tonnes, equipped for launching missiles with a range of at least 25 kilometres or torpedoes with similar range.[51]

The 2024-2025 GGE has been tasked with continuing to consider how best to ensure armed uncrewed systems that fulfil category descriptions are reported in submissions to the Register.[52] In particular, the 2022 GGE highlighted that UMS developments could necessitate an adjustment of the Register's categories:

Experts discussed the merits of including a subcategory for unmanned vessels and submarines that could be lighter and have different characteristics to those contained in the current description. Lighter vessels and submarines being developed and due for entry into service around the time of the next scheduled Group of Governmental Experts in 2025 could be used in attacks on larger warships or used for attacking critical infrastructure, such as underwater cables.[53]

Section 4 below considers whether the GGE should go further and create a new subcategory of Category VI or create a new, separate category for armed UMS.

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48 United Nations, General Assembly, "Continuing Operation of the United Nations Register of Conventional Arms and Its Further Development", A/61/261, 15 August 2006, https://docs.un.org/A/61/261.

49 Now titled "Combat aircraft and unmanned combat aerial vehicles (UCAV)." United Nations, General Assembly, "Continuing Operation of the United Nations Register of Conventional Arms and Its Further Development", A/71/259, 29 July 2016, https://docs.un.org/A/71/259.

50 Now titled "Attack helicopters and rotary-wing unmanned combat aerial vehicles". United Nations, A/77/126.

51 United Nations Register of Conventional Arms, "Categories", n.d., https://www.unroca.org/categories.

52 United Nations, A/77/126.

53 United Nations, A/77/126, 63.

BOX 3.

The Register's influence on other Instruments

When considering enhancing mechanisms for transparency in armaments to include armed UMS, it is important to note that the Register has become a key reference point for determining the scope of other instruments relating to conventional arms control and transparency in international arms transfers.

The scope of the ATT, for instance, is aligned with the scope of the Register at the time of the entry into force of the ATT in December 2014.[54] As of January 2025, there are 116 ATT State Parties, 113 of which are obliged to report annually on their international arms transfers.[55] The Organization for Security and Co-operation in Europe also uses the Register's categories as a reference point for its annual information exchange on conventional arms transfers,[56] and these categories are also used for the Inter-American Convention on Transparency in Conventional Weapons Acquisitions.[57]

By setting a new precedent in relation to UMS, the Register has the opportunity to once more take on a leading role and enable reporting on international transfers and acquisitions of armed UMS. Since such vessels are increasingly relevant for maritime warfare, adapting the Register could represent an important contribution to the objective of fostering mutual trust in order to enhance stability and peace in an increasingly complex world.

3.2. Limitations and Challenges of the Register in Relation to UMS

International transfers of armed UMS should be reported by States in Category VI of the Register reporting form if such vessels meet the requirements of the current description for "Warships". However, as shown in Section 2, most of the armed UMS currently in development fall outside the current technical description because their standard displacement is well below 500 tonnes and they are generally not equipped to launch missiles or torpedoes with a range of at least 25 km.

Most of the UMS known to be weaponized have a standard displacement of between 1– 10 tonnes and are equipped with missiles with a range under 11 km (see Figure 7). Nevertheless, there is at least one surface UMS that has launched a surface-to-surface missile with a range of 40–50 km – therefore falling

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54 Arms Trade Treaty, 2013, https://www.thearmstradetreaty.org/treaty-text.html?templateId=209884.

55 ATT Secretariat, "Treaty Status", n.d., https://www.thearmstradetreaty.org/treaty-text.html?templateId=209884.

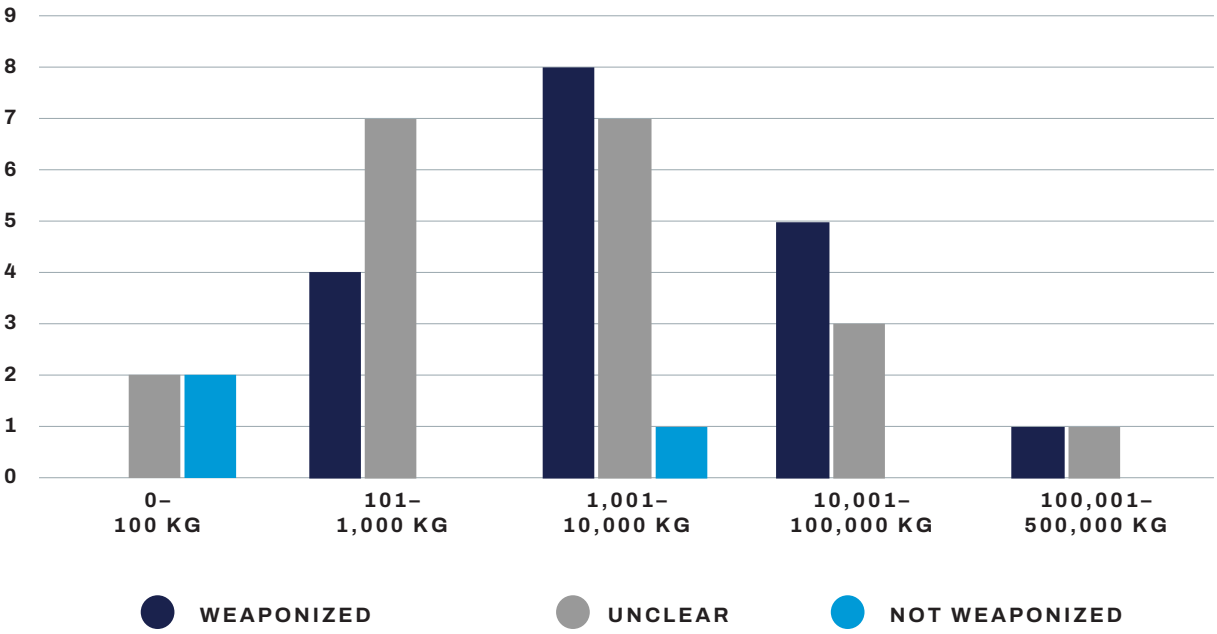
56 Mark Bromley and José Francisco Alvarado Cóbar, *Reporting on Conventional Arms Transfers and Transfer Controls: Improving Coordination and Increasing Engagement* (Stockholm: SIPRI, 2020), https://www.sipri.org/sites/default/files/2020-08/2007_reporting_on_conventional_arms.pdf.

57 Inter-American Convention on Transparency In Conventional Weapons Acquisitions, 1999, https://www.oas.org/en/sla/dil/inter_american_treaties_A-64_transparency_conventional_weapons_adquisitions.asp.

well within the definition of Category VI.[58] However, under current reporting practices, the only way to know if such a vessel has been transferred or acquired is if a State reporting a transfer to the Register explicitly provides information on the model using the "Description of item" column in the reporting form. Unfortunately, use of this column is not universal.

FIGURE 7.

Weaponization of UMS programmes, by displacement, 2019–2024



Source: UNIDIR analysis

Currently, if States are transferring any of the UMS highlighted here, it is unlikely that they would report such transfers under Category VI of the Register because its current description does not cover these vessels. Therefore, if Member States are concerned about the threat to international peace and security that UMS pose, they need to change the scope of the Register.

[58] This is the Turkish Marlin surface vehicle, which fired KUZGUN_KY surface-to-surface missiles. See Tayfun Ozberk, "Are Unmanned Surface Vehicles a Paradigm Shift in Naval Warfare?", DSA Exhibition and Conference SDN BHD, 22 September 2023, https://www.dsaexhibition.com/are-unmanned-surface-vehicles-a-paradigm-shift-in-naval-warfare; "Marlin USV Fires KUZGUN-KY from Fixed Launcher", TurDef Global Defence News, 2 October 2024, https://turdef.com/article/marlin-usv-fires-kuzgun-ky-from-fixed-launcher.

4. Exploring Pathways to Increase Transparency on International Transfers and the Acquisition of Armed UMS

As noted in Section 3.2, the vast majority of armed UMS currently in use or development fall below the reporting threshold of the current technical description for Category VI. Several ways forward could be considered, not all of which are mutually exclusive.

A **first option** could be to follow the recommendation put forward by the 2022 GGE, in other words, to report international transfers of any uncrewed vessel that meet the criteria of existing categories. The GGE recommended that the current technical characteristics for Category VI (regarding standard displacement and missile and torpedo range) be maintained, but the annual request to report would explicitly state that Member States should report on international transfers and the acquisition of uncrewed vessels that fulfil such technical characteristics. Member States should then be encouraged to indicate in the reporting form if a vessel is uncrewed, using the "Description of item" column. Unfortunately, as shown here, this is unlikely to lead to an increase in information on the acquisition of armed UMS since their standard displacement is typically below 500 metric tonnes and these vessels are armed with missiles and torpedoes that have ranges below 25 km.

A **second option** could be to amend the current technical characteristics to widen the scope for reporting on armed UMS. This option would most likely take the form of significantly reducing the threshold for standard displacement to more accurately reflect the standard displacement of armed UMS. However, such an approach is unlikely to find consensus in the GGE because it significantly increases the reporting burden for reporting on exports and imports of vessels and could lead to the inclusion of crewed coastal patrol vessels, which are not considered a threat to international peace and security.

A **third option** could follow the approach taken for aircraft: UAS were explicitly included in Category IV "Combat aircraft and unmanned combat aerial vehicles (UCAV)" and Category V "Attack helicopters and rotary-wing unmanned combat aerial vehicles" by changing each category title and creating a subcategory in each with specific technical characteristics and functions for uncrewed systems that differ from the crewed systems. This approach could be replicated for Category VI to include armed UMS that pose a threat to international peace and security and maintain the current description for crewed "Warships".

A **fourth option** could be to create a new category for "Armed UMS", distinct from crewed "Warships". Such an approach seems unlikely given the approach taken for including UAS in the Register.

There are, of course, counterarguments to updating Category VI. It could be argued that, even if there is a clear means to report to the Register on international transfers of armed UMS, this would only provide a partial picture on the proliferation of UMS because it would not include vessels procured through national production. While Member States are invited to provide information to the Register on procurement through national production and military holdings, few reporting States use this

option.[59] This is therefore a wider issue that affects all the Register weapon categories, and so is not solely applicable to armed UMS. As such, discussions on the expansion of the Register's scope could extend to also cover information on procurement through national production at the same level as for international transfers.

5. Conclusion

Overall, there is heightened interest in acquiring and using UMS, from both State and non-state actors, due to their force-multiplier effects in the maritime domain and the possibilities they offer that complement or go beyond those of crewed systems. Recent technological advancements, such as AI, have enabled or improved many of the capabilities that armed UMS possess, and continued research and development is likely to further accelerate this process.

Trends in UMS are characterized by a growing number of producers and end users, an increasingly blurred line between civilian and military applications, and increased use for offensive operations. This makes UMS a challenging type of system for transparency in armaments. Yet, given that armed UMS can pose a significant threat to international peace and security, building trust between States on who is acquiring such vessels in a period of heightened political tensions is critical.

This Insight provides several options for consideration by the current GGE on the Register and, more broadly, for States to increase transparency in international transfers and the acquisition of armed UMS. It also provides important considerations to overcoming the omission of armed UMS from the Register and risks that would follow from not making amendments to the Register's scope now.

The Register was envisioned to be a dynamic and adaptable tool for enhancing transparency in armaments. Given this, current and future developments of UMS are creating an increasingly pronounced need for this adaptability to be put into practice. Ensuring that the Register remains responsive to change will reinforce its relevance and its role in strengthening peace and security across all regions.

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[59] Paul Holtom and Anna Edna Esi Mensah, "The End of Transparency in International Arms Transfers?", Commentary, UNIDIR, 14 September 2022, https://unidir.org/commentary/end-transparency-international-arms-transfers.

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