Undersea dragon: Chinese ASW capabilities advance

Although the People's Liberation Army Navy has grown significantly in terms of size and strength, its ability to counter undersea threats remained modest until recently. *Kelvin Wong* tracks how the service's anti-submarine warfare capabilities have expanded from coastal defence to blue-water operations

The People's Liberation Army Navy (PLAN) continues to modernise itself into a leading regional naval power, able to assert maritime dominance against less-capable opponents in the Asia-Pacific region, while striving to counter the US Navy's (USN's) longstanding regional prominence.

The Type 056 corvettes have been configured for anti-submarine missions with a bow-mounted sonar, variable depth sonar, and a SJG-206 towed array. (Gordon Arthur)

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Unlike the 'fortress navy' of the 1980s, which largely comprised patrol craft and had to rely on land-based support even to defend its waters, the contemporary PLAN is capable of independent action and power projection along the country's periphery and into the Pacific Ocean with its increasingly sophisticated fleet of surface and underwater combatants, as well as concomitant air and auxiliary support.

Indeed, a June 2016 report released by the Washington-based Center for Naval Analysis – a federally funded research and development (R&D) centre serving the US Department of the Navy

and other US defence agencies – has suggested that the PLAN will likely have commissioned a fleet that may exceed 270 vessels by 2020, making it the largest navy in terms of size and the second-most-capable blue-water naval force in the world by 2020.

Despite this, it has been widely acknowledged that the PLAN remains comparatively weak in countering underwater threats. The US Department of Defense (DoD), for example, noted in a report on China's military capabilities that anti-submarine warfare (ASW) remains an observed weakness, with the service continuing "to lack either a robust coastal or deep-water anti-submarine warfare capability".

Beijing is cognisant of this potentially game-ending deficiency and has devoted considerable resources to boosting the PLAN's ASW capabilities in recent decades. For example, a large proportion of its modest ASW capability resided in its large but now dwindling fleet of 58 m-long Hainan-class (Type 037) patrol craft/submarine chasers – which were equipped with the Stag Ear hull sonar with variable depth sonar (VDS) in some vessels. For the ASW role, these patrol craft are armed with as many as four RBU 1200 5-tube fixed launchers that fire rockets with 34 kg warheads set to detonate on impact or time delay to depths in excess of 400 m, as well as two BMB-2 depth charge projectors. However, these weapons were only useful against shallow diving submarines or in littoral waters and were largely ineffective against fast and deep-diving nuclear submarines.

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Principal ASW weapon development efforts

A major effort to arm the PLAN with an effective lightweight ASW torpedo began in the 1980s with China Shipbuilding Industry Corporation subsidiary Xi'an Precision Machinery Institute (705th Research Institute) and the Northwestern Polytechnical University. These institutions are understood to have been the principal design agencies for the programme, although full-scale production – which may have begun as early as 1984 – likely involved multiple agencies and manufacturing facilities.

The basis of this early effort is believed to be founded on the Italian 324 mm A244/S Whitehead torpedo manufactured by WASS - now part of Leonardo Defence Systems (formerly Finmeccanica) - approximately 40 of which were acquired for evaluation and trial by the PLAN in 1987. There is some suspicion that the developmental effort was aided by US-made Mk 46 Mod 2 technology exploited from an unexploded torpedo trawled up by a Chinese fishing vessel in the South China Sea in 1978 and transferred to the PLAN, although the extent of reverse-engineered US technology cannot be ascertained.

Following extensive trials at the 750 Testing Range in Kunming up to 1988, the Chinese version of the A244/S torpedo, known as the Yu-7 (Fish-7), subsequently emerged and entered service with the PLAN in the early 1990s. It eventually armed all major PLAN surface vessels fitted with a torpedo-launching system, such as the Leonardo B515/ILAS-3 launcher and its Chinese derivatives, as their principal ASW weapon. These were first observed on board some Luda-class (Type 051) destroyers and the Harbin Z-9C shipborne helicopter.

The Yu-7 torpedo has a length of 2.7 m and a launch weight of 235 kg. The torpedo was initially equipped with an electric propulsion system, but this was eventually deemed too slow to defeat newer and more capable Western submarines – regarded as the principal threat to maritime

security – and the torpedo was subsequently redesigned to accommodate an Otto II fuel system for a higher attack speed in excess of 45 kt.

The torpedo is armed with a 45 kg shaped charge warhead and employs a CIACIO-S seeker capable of active and passive search and attack and homing to a target. It has a conventional layout with the guidance system and warhead in the forward section. The operating envelope is unknown, but it is expected to be comparable with that of the A244/S's 400 m depth and out to a range of 7.6 n miles.

A new lightweight torpedo – designated the Yu-11 – emerged around July 2015 when a new and visibly longer weapon – equipped with a pump jet propulsor in contrast to the Yu-7's contrarotating propellers – was seen being released from a Type 7424 (B515/ILAS) triple 324 mm torpedo tube launcher mounted on an unidentified surface combatant.

The pump jet propulsion appears to be the most noteworthy improvement. The engine design will potentially permit a greater operating depth of more than 600 m, enabling the weapon to counter modern Western nuclear-powered submarines and the increasingly capable conventional submarines operated by China's regional rivals, which are seen to be the most likely threat. The pump jet also reduces the weapon's radiated noise, making it harder for an intended target to detect its approach via passive sonars and to deploy countermeasures.

The Yu-11 has a length in excess of 3 m with a correspondingly higher launch weight. It is expected to supplant the Yu-7 as the standard lightweight torpedo for the PLAN's surface fleet and ASW helicopters. However, the physical differences between these torpedoes will likely necessitate modifications to the ship magazine, torpedo handling, and torpedo tubes in the older surface-ship classes, although it is believed that the Yu-11 has been fitted in all modern vessels entering service since 2012.

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Details of the CY family of rocket-assisted torpedoes remain scant, although it is reported as having entered service by around 1993 and has been seen carried on a number of surface combatants, including Type 051 destroyers and the Jiangwei I (Type 052H2G)-class frigates. It is believed that initial operational trials were conducted by Type 051 destroyers, followed by the Type 052 frigates.

Reports indicate that the rear half of the CY-1 has been developed from the YJ-1 (Ying Ji or Strike Eagle) surface-to-surface missile (SSM) to carry a lightweight torpedo payload (likely the Yu-7 lightweight torpedo), which suggests that the weapon – which has an estimated launch weight of 700 kg and overall length and diameter of 5.5 m and 410 mm, respectively – is compatible with C-801/802/803 launchers and can therefore be carried by any surface combatant with mountings for these missile canisters. The solid propellant motor of the CY-1 is believed to be capable of attaining a maximum speed of 600 kt and can carry its lightweight torpedo payload out to a range of 9.7 n miles to the vicinity of an underwater threat, where the torpedo separates from the rocket delivery vehicle and enters the water to begin its search and attack routine.

Development of the CY rocket-assisted torpedoes has progressed in lockstep with the YJ-series SSMs, with the subsequent CY-2 and CY-3 rocket sections derived from the turbojet engines based on the C-802 missile. However, it became apparent around 2014 that a new and much more capable rocket-assisted torpedo system, the CY-5/Yu-8 (its nomenclature is somewhat confusing because the system is called the CY-5 and the associated weapon is identified as the

Yu-8 ASROC-type missile), had entered service in the latest generation of PLAN frigates and destroyers with vertical launchers and is carrying the new Yu-11 lightweight torpedo as the payload.

The CY-5 system is understood to have been fitted to the Jiangkai I (Type 054A) frigate and Luyang III (Type 052D) destroyer and is expected to be included in future platforms with similar vertical launch systems (VLS), combat management systems (CMS), sonars, datalinks, and ASW helicopters.

The CY-5 is believed to be in excess of 5.5 m in length and weighs less than 800 kg, including the torpedo. The maximum range of the rocket delivery vehicle is assessed to be approximately 16.2 n miles at a speed in excess of 650 kt. Targeting data may be provided by the ship's own sonar suite, or acquired from a separate platform such as an ASW helicopter or another surface combatant via a datalink. The targeting calculations are processed in the CMS and the missile is pre-programmed to an intercept splash point, while the torpedo is provided with the search-and-attack pre-settings prior to launch.

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Sensor development

China is also rapidly fielding new and more capable surface combatants outfitted with considerable ASW capabilities. These are believed to be indigenously developed VDS and towed sonar arrays, although it is likely that the technology may have been derived from Western systems acquired during the 1970s.

Later builds of the PLAN's Type 054A missile frigate design are understood to be equipped with a variable depth sonar for improved anti-submarine warfare performance. Seen here is the frigate Yulin. (IHS Markit/Kelvin Wong)

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It is understood that China contracted France in 1974 to provide sonar systems such as the DUBV 23 search sonar and DUBV 43 low-frequency VDS, which were used to outfit the first Luda III (Type 051G) conversion in 1990 and the two newly built Luhu (Type 052A)-class DDGs in 1993. However, there is strong suspicion that China has reverse-engineered these devices – along with other Western products, believed to include the Raytheon DE 1164 VDS – to accelerate development of its own indigenous efforts.

Photographic details on the PLAN's VDS system broke cover in a December 2016 local media report on a major naval exercise that purportedly involved major surface combatants such as the Type 054A frigate and the latest Type 052D destroyer, submarines, aircraft, and shore-based units.

Jane's analysis of these images notes that the Type 052D destroyers could be equipped with a credible underwater sensor capability that appears to include a VDS being deployed in parallel with a linear towed array sonar. A similar configuration can be found on ASW-optimised Type 054A frigates and Type 056A corvettes, although there is likely to be some distinction between the ship classes owing to fitting constraints.

The Type 052D VDS is deployed through a hinged opening in the ship's transom and lowered into the water via a hydraulic lifting mechanism. Images depict the body of the VDS as featuring a streamlined fairing fitted with Y-shaped hydrodynamic vanes for towing stability, while the acoustic modules of the linear towed array are housed within an oil-filled transparent hollow tube containing the passive sonar elements and connecting cables.

The PLAN's latest Type 052D guided-missile destroyer is equipped with a variable depth sonar and a linear towed sensor array. These were demonstrated in a major naval exercise in December 2016. (People's Liberation Army Navy)

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Surveillance technology

China earlier announced plans to upgrade a civilian network of communications and sensor systems deep in the western Pacific that it says are used in scientific research, according to a 1 January 2017 report by state media agency Xinhua. The system comprises buoys anchored between 400 m and 500 m beneath the surface of the western Pacific to conduct research on areas such as climate change and ocean currents.

According to researchers quoted by Xinhua, the buoys will be upgraded by the end of 2017. The upgrade will enable the communications equipment in the buoys to transmit amassed data directly back to research facilities in China via satellite . The update will enable the submerged buoys to

send data to surface anchor points through a cable or wirelessly via sound waves, which will then relay the information to a communications satellite.

The report also stated that China has deployed hundreds of buoys, including nearly 20 deep anchor points in unspecified depths in the western Pacific since 2014. However, Wang Fan, deputy director of the Qingdao-based Institute of Oceanology at the Chinese Academy of Sciences, said data from these buoys can only be collected once a year by manually retrieving hard drives, as it is difficult to make radio contact with the sensors underwater.

The system functions at the operational depth of nuclear submarines, suggesting the military could already be using a similar undersea network to communicate with the vessels, according to other researchers familiar with the technology.

The data collected could also support PLAN undersea operations; readings of water speed, temperature, and salinity collected by the deep-sea sensors could potentially be exploited by Chinese submarines to avoid turbulence while providing a safe and efficient method of communicating with surface assets or shore facilities. It is also likely that the buoys might be employed to record and monitor the passage of submarines operated by other navies, providing a rudimentary method for early warning of suspicious or potentially hostile activity.

However, Professor Li Xiaodong, director of the communication acoustics laboratory at the Institute of Acoustics at the Chinese Academy of Sciences, told media that a number of challenges must be resolved before such technologies can be harnessed effectively.

According to Li, wireless communication with sound waves could theoretically be achieved at distances over 10,000 m in deep, quiet environments, although he also noted that the effective range degrades swiftly in the presence of background noises generated by maritime traffic and marine animals.

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Airborne ASW

The airborne element of the Chinese ASW triad is likewise benefiting from the country's overall efforts to counter underwater threats, with new platforms recently appearing in the public domain.

In August 2014, local media reported that a new ASW-optimised naval helicopter is undergoing trials and testing. The latest helicopter is believed to be designated the Z-18F and is a further development of the Changhe Aircraft Industry Group (CAIG) Z-8, itself a copy of the French SA-321 Super Frelon.

The Z-18F is optimised for anti-submarine warfare, although its 13.8-tonne maximum take-off weight precludes its deployment on smaller PLAN surface combatants. (Ministry of National Defense)

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Imagery analysis of the public images suggests that the Z-18F has a redesigned cockpit and modified hull form, while previous company statements claim that the helicopter is fitted with a new type of engine – possibly a development of the WZ-6 derivative of the Turbomeca Turmo 3C that powers the Z-8 – and composite main rotor blades, with lightweight composites and titanium employed extensively in its construction.

The Z-18F is equipped with dipping sonar and reports suggest it can carry up to 32 sonobuoys and four lightweight torpedoes, such as the Yu-7. It is equipped with a chin-mounted surface search radar and it is likely that the helicopter has been fitted with a datalink similar to that of the Kamov Ka-28s already in PLAN service, enabling it to perform targeting for long-range anti-ship cruise missiles (ASCMs) launched from friendly surface combatants.

Jane's Market Forecast expects that as many as 39 of these dedicated ASW helicopters will be acquired by 2023, including 20 to replace ageing Z-8 platforms in current service.

The PLAN is also inducting an increasing number of the maritime patrol and ASW variant of the four-engined Shaanxi Aircraft Corporation (SAC) Y-8/Y-9 medium transport turboprop aircraft. Designated the Y-8Q, but also identified by its project name of Y-8GX6 (Gaoxin-6), the service's latest fixed-wing ASW platform has an estimated range of approximately 2,670 n miles and a patrol endurance of up to 10 hours.

China's latest fixed-wing anti-submarine warfare platform is now being inducted into operational squadrons. (Via Chinese Internet)

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Details of the Y-Q8's ASW mission systems remain scant, but it is believed to be outfitted with a range of indigenous sensors, including the SQ-55. Visible features include a prominent magnetic anomaly detector (MAD)-equipped tailboom, a large chin radome that likely houses a surface search radar, and a small electro-optical/infrared (EO/IR) turret just aft of the nosewheel.

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