Chinese Submarines and U.S. Anti-Submarine Warfare Capabilities

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ELENI EKMEKTSIOGLOU AND MATTHEW HALLEX, AUG 27 2011

China's military modernization has been a source of great concern for the United States and its allies in the Asia-Pacific region. American anxiety has been fueled by double digit defense budget increases over the last decade along with the veil of mystery that covers Chinese defense spending. Much of these funds have been devoted to the acquisition of platforms and weapons that will allow China to implement Anti-Access/Area Denial strategies (A2/AD.)[1] Despite the growth of Chinese economic and military power, it is in no position to challenge the United States and in particular the U.S. Navy on equal footing.

Sea control in the face of U.S. maritime power is still beyond the People's Liberation Army Navy (PLAN) but sea denial is an achievable goal.[2] Sea denial aims not to eliminate U.S. naval forces but drawing on the same toolkit as insurgents, aims to inflict unacceptable costs on enemy forces and erode their political will to continue fighting.[3] Such a strategy relies upon an asymmetric approach – confronting U.S. surface forces with PLAN surface forces would serve to play to the strengths of the United States. Rather, the PLAN aims to inflict unacceptable costs by focusing on the weaknesses of the United States. Multi-layered Chinese systems, threatening U.S. forces from the land, the surface, the air, and under the waves could threaten to deny access to key strategic areas to the United States.

Submarines, unsurprisingly, can be expected to play a significant role in Chinese asymmetric A2/AD strategies.[4] The inherent stealth of submarines makes anti-submarine warfare (ASW) one of the most difficult tasks facing a modern navy. This challenge is complicated further by Chinese acquisition of new nuclear (SSNs) and advanced conventional submarines (SSKs.) When armed with advanced torpedoes, sea mines, and anti-ship missiles, even relatively unsophisticated submarines can pose a significant threat to U.S. surface forces, including the aircraft carriers that are the heart of the U.S. ability to project power into the Western Pacific region.

This paper will address the role submarines are likely to play in Chinese maritime strategy. It will review the structure of the Chinese submarine force and procurement trends that are shaping its future structure. China has identified a growing gap in U.S. military capabilities since the end of the Cold War and this paper will identify some of the operational uses and missions of submarine the PLAN will likely use to exploit it. The paper will also review current weaknesses in U.S. ASW capabilities, efforts currently underway to address them, and conclude with suggestions of further steps that should be taken to improve the ability of the U.S. to properly exploit the undersea domain.

Chinese Submarine Forces

Modernization and expansion of the submarine fleet has been a high priority for the People's Liberation Army Navy. Acquisitions from abroad as well as a number of indigenous development programs have added advanced conventional and nuclear submarines to China's fleet. In addition to bolstering the number of vessels deployed by China, the acquisition of new weapons systems have made Chinese forces a more potent threat to U.S. and allied forces in the region.

Force Size

While China has maintained a number of obsolete vessels in service, procurement in recent years has been focused on replacing outmoded vessels and increasing the size of the force. According to the Congressional Research Service, the PLAN's annual commissioning rate of 2.6 submarines of all types will eventually result in an undersea force of 53-79 submarines.[5] The final size of the submarine force will depend upon China's choice of deploying large numbers of less costly diesel-electric submarines or acquiring a smaller force of nuclear submarines.

Platforms

Beginning in the 1990s, China undertook an extensive modernization of its submarine force. Initially, the PLAN focused on acquiring advanced submarines from abroad and purchased 12 Kilo class submarines from Russia in 2002. In addition to foreign acquisitions, China has indigenously developed four classes of submarines including a nuclear ballistic missile submarine (Type 094/Jin-class), a nuclear attack submarine (Type 093/Shang-class) and two classes of conventional diesel electric submarines the Song and Yuan classes.[6] The Yuan class is believed by many analysts to be equipped with an Air Independent Propulsion (AIP) system which would significantly improve its stealth capabilities.[7]

In addition to the new submarines that have been fielded, China is developing two additional submarine classes that represent steps towards a sophisticated submarine force. China seems determined to develop an improved version of its indigenously produced Shang class nuclear attack submarine. According to the U.S. Office of Naval Intelligence report, this improved attack submarine is expected to enter service in 2015.[8] An improved variant of the Yuan class is also under production. This variant is reported to be notably different from its predecessors and incorporates a number of features from the Kilo class submarines acquired from Russia.[9]

Weapons Systems

Procurement of advanced weapons systems is key to making China's newly acquired submarines an effective fighting force, in addition to boosting the combat capabilities of China's current forces. Chinese submarines are equipped with wake-homing-torpedoes which can threaten U.S. surface forces. Kilo-class submarines are equipped with the SS-N-27 Sizzler anti-ship missile. The Sizzler is a supersonic sea skimming missile designed to defeat the Aegis missile defense system deployed by the U.S. Navy.[10] The Yuan and Song class submarines are expected to be equipped with the new CH-SS-NX-13 anti-ship missile when it completes development and testing. As well as being able to threaten U.S. surface vessels, Shang class submarines are capable of firing land attack cruise missiles that would allow it to threaten bases in the region and other infrastructure that support U.S. power projection in the Western Pacific.

The Chinese Submarine Force in the Context of a Sea Denial Strategy

Chinese procurement trends suggest a preference for smaller and stealthier submarines rather than long-range endurance platforms. While China is moving towards a blue water navy, it is capitalizing on advantages conventional submarines present to green water navies. Conventional submarines, particularly those equipped with AIP systems, can operate with a greater degree of stealth and freedom in the waters near China than larger U.S. nuclear submarines. Advanced weapons systems deployed on submarines along with land based missile and air forces would serve to deny the waters near the Chinese coast to U.S. and other combat forces.

While U.S. submarines play an important role in ASW activities, Chinese operational planners seem to focus more on the development of anti-surface warfare (ASuW) doctrine enabled by stealthy conventional submarines. Through the purchase and indigenous production of quiet diesel-electric boats, China intents to create a 'ghost' submarine force that would move silently along the Chinese coast looking for possible surface targets while avoiding encounters with the enemy's submarine force. The difficult underwater geography of the littoral region as well as the noise from coastal shipping, fishing, and other economic activities make it an ideal operating environment for China's submarines. Chinese investments in hydrographic studies enhance its knowledge of the underwater topography, thermoclines, and other elements of the coastal area and would allow the PLAN to take full advantage of the opportunities offered by the Chinese coastal operation theater.[11]

While Chinese operational plans and possible missions for their submarine force remains opaque to outside analysts, the limitations of their current systems suggest that submarine forces are unlikely to operate independently. Rather, as Admiral McVadon suggests in the *Naval War College Review*, Chinese submarine forces would work in coordination with shore based missile systems.[12] Given that older Chinese submarines would encounter difficulty attempting to penetrate U.S. ASW defenses to conduct anti-surface strikes under normal conditions, the PLAN would be more likely to wait until missile strikes launched from the mainland had degraded U.S. missile defenses before launching anti-ship missile and torpedo attacks.

The supersonic Sizzler ASCM fired by Kilo class submarines could threaten U.S. surface forces if launched in sufficiently numbers, or if a Kilo managed to surprise its target.[13] The subsonic missiles and torpedoes carried by the rest of the Chinese submarine fleet would be easier for U.S. forces to defeat but they could still pose a significant threat to U.S. surface vessels after U.S. defenses were degraded by other attacks. Older submarines including the Ming, Romeo, and Han class vessels based on obsolete Soviet designs, can also pose a threat. Such submarines could act as mine layers or as bait, bringing in U.S. submarines and ASW forces into the range of missiles carried by more advanced Chinese submarines.

The technological developments undertaken by the Chinese submarine force have had an impact on the PLAN's assessment of their own capabilities and roles. The Kitty Hawk incident, in which a Chinese submarine surfaced in the midst of a U.S. carrier battle group, suggests that Chinese submariners are confident in their ability to avoid detection by U.S. ASW escorts.[14] Such incidents as well as an increasing number of submarine patrols suggest that China aims at operating its forces further afield in the region and sending the message across that China is a non-negligible maritime power in the Asia Pacific.[15]

The United States and the Chinese Undersea Challenge

While the submarine forces of the PLAN have expanded and improved their technological capabilities, the ASW capabilities of the United States have eroded. Throughout the Cold War the United States faced a persistent threat from Soviet submarines and ASW was to be a primary mission of the U.S. Navy during a conflict as it attempted to eliminate Soviet sea based nuclear forces and ensure that sea lanes to NATO allies in Europe remained open. The fall of the Soviet Union eliminated the undersea peer threat to the United States and ASW has not been a major component of U.S. naval operations in recent conflicts. The U.S. has retained qualitative and technical superiority in the undersea domain but ASW capabilities have suffered in recent decades.

Much of the difficulty faced by U.S. ASW forces stems from the technical challenge posed by the stealth of advanced conventional submarines. Conventional submarines operating on battery power have a smaller passive sonar signature than nuclear submarines which must keep their reactor machinery operating. AIP systems serve to extend the period in which SSKs can operate quietly making them more capable and more difficult to detect.

In addition to the technical challenge posed by modern conventional submarines forces, the balance of undersea forces in the Pacific is shifting. While the PLAN expands its submarine forces, U.S. naval forces are drawing down. The current shipbuilding plan of the U.S. Navy envisions a reduction in submarine forces to a fleet of only 39 nuclear attack submarines in 2030, significantly less than the 48 that the Navy projected as necessary to fulfill future missions.[16] While U.S. submarines are unmatched technologically, their low numbers will be a significant shortcoming due to the heavy demands that would likely be placed on them to perform both strike and ASW missions during a potential conflict between the U.S. and China.

Other shortfalls in U.S. ASW capabilities can also be expected. Anti-submarine warfare is a planned mission for the Littoral Combat Ship (LCS), a program which has proven to be deeply troubled. Currently deployed LCSs have developed significant problems with structural damage due to corrosion. The LCS also lacks organic ASW capabilities and is not equipped with the towed sonar array found on previous dedicated ASW combatants. Rather, the LCS can be equipped with an ASW mission module when necessary that is projected to include unmanned undersea vehicles (UUVs) and unmanned aerial vehicles (UAVs) that can carry out ASW missions. The LCS mission modules are facing a number of development hurdles and are significantly behind schedule.[17] U.S. aerial

ASW capabilities have similarly eroded. The U.S. retired the S-3 Viking leaving U.S. carriers without a fixed wing ASW capable aircraft. While the U.S. is replacing its P-3 Orion maritime surveillance and ASW aircraft with the advanced P-8, such aircraft must operate from land bases. While the P-8 will likely be a highly capable ASW combatant, the bases it operates from would be highly vulnerable to the types of missile and air attacks that would be integral to a Chinese A2/AD strategy.

While the U.S. Navy faces significant challenges in the ASW arena, it has taken a number of steps to cope with the increased threat posed by Chinese and other submarines. U.S. naval forces in the Pacific have placed a renewed emphasis on ASW training. As part of an effort to build greater familiarity with conventional submarines equipped with AIP systems the U.S. conducted two years of training with the Gotland, an advanced Swedish diesel submarine.[18] Such training continues as part of the Diesel Electric Submarine Initiative which involves regular training exercises involving U.S. ASW forces and the conventional submarines of allies.[19] While this training is a step in the right direction, exercises have demonstrated that advanced diesel submarines are highly capable threats that can threaten major U.S. surface combatants.

Shipbuilding shortfalls are unlikely to be improved due to expected future cuts in the U.S. defense budget and the significant problems that plague current U.S. navy procurement efforts. The U.S. has coped, in part, by shifting its current forces to better face the threat posed by expanding Chinese capabilities. The U.S has permanently home ported four Los Angeles class submarines and a tender in Guam and shifted other submarines to bases in Hawaii and California.[20] The U.S. is also planning to base future LCSs in forward bases in Singapore.[21] While forward deployment does risk putting the infrastructure supporting U.S. ASW forces within range of Chinese missile systems, it would also reduce the transit time for U.S. forces, allowing them to deploy more quickly and remain in theater longer during a conflict.

The shortcomings in China's own ASW capabilities would allow U.S. submarine forces to disrupt Chinese attempts to project power in the region and threaten PLAN surface forces. Cruise missile armed U.S. submarines would also play an important role in strikes against targets within China. During Desert Storm just 10% of missile strikes came from subs, while one third of such strikes were launched from submarines during the conflicts in Afghanistan and Iraq.[22] The conversion of Ohio class ballistic missile submarines to guided missile submarines (SSGNs) has expanded this capability further. U.S. submarines represent a power projection force that is relatively immune to Chinese A2/AD capabilities as they can't be threatened by air and missile forces and China currently lacks ASW forces to credibly threaten them. While the striking abilities of U.S. undersea forces will be diminished by the retirement of Ohio class SSGNs, they represent a threat that the PLAN lacks the ability to credibly respond to.

Recommendations for the United States

Shifting submarines forces to the Pacific and increasing ASW training is an important first step in responding to the challenge posed by China's expanding and improving submarine forces. However, it is insufficient. There are a number of steps the United States could take to improve the undersea balance of power in the Asia Pacific region. Submarines are a vital asset which can serve as the primary ASW tool for U.S. naval forces, and which can carry out strike missions without interference from Chinese A2/AD systems. Addressing the shrinking size of the U.S. fleet is vital. The U.S. Navy should continue its efforts to improve the cost effectiveness of its current procurement programs and consider shifting a larger portion of the shipbuilding budget to submarine acquisition. In particular, the U.S. should procure additional guided missile submarines to replace retiring Ohio class SSGNs and to expand the ability of the U.S. to strike targets despite China's deployment of A2/AD systems.

The United States should also invest in new technical solutions that could bolster American ASW capabilities. Unmanned surface and underwater vehicles are increasingly capable and further development in this area would provide alternatives to expensive and vulnerable manned assets. Ships deploying a number of unmanned sensors from a standoff distance would be better able to detect stealthy submarines while being less vulnerable to Chinese missile attacks. Deploying fixed sensors in strategic points in the waters near China would also improve the ability of the U.S. to detect PLAN submarines. During the Cold War fixed acoustic sensors deployed between Greenland, Iceland, and the United Kingdom allowed U.S. forces to detect Soviet submarines as they entered the North Atlantic.

Similar systems could serve as tripwires for the entrances to the Western Pacific from the South China Sea. The cooperation of Vietnam and the Philippines would be required for the deployment of the shore based support infrastructure, but as Chinese naval deployments grow more threatening, the support of these states is more likely to be forthcoming.[23]

Some analysts have suggested that the United States should develop conventional submarines of its own.[24] Conventional powered submarines could be less expensive to procure than current nuclear vessels and their small size and stealthy capabilities would be better suited for operating in the Chinese littoral. Despite the potential tactical and financial advantages that conventional submarines offer, the United States should continue to deploy a nuclear attack submarine force. The U.S. lacks the industrial base to construct conventional submarines and acquisition from foreign suppliers would be politically difficult. Nuclear submarines are also capable of faster transits from bases in the United States, Hawaii, and Guam to the Western Pacific, which could be vital in a crisis. The larger size and power of nuclear submarines also allow them to support more complex sensor systems which are increasingly necessary for ASW work.

Conclusions

PLAN submarines play an important role in Chinese A2/AD strategies. While they are not as novel of a threat as anti-ship ballistic missiles, their numbers and increasing sophistication pose a severe threat to shrinking U.S. submarine and surface forces. China's submarine force is likely to expand in the future and develop increasing long-range and blue ocean capabilities that can attempt to push U.S. forces further from Chinese home waters. The United States must invest to maintain the superiority of its undersea forces and to relearn and redevelop the core ASW capabilities it lost following the end of the Cold War and the Soviet submarine menace. Beyond ASW, submarines also represent a capability that is relatively immune to Chinese A2/AD strategies. The ability of U.S. submarines to operate in environments too dangerous for surface ships should be a serious consideration in future procurement and investment decisions.

Eleni Ekmektsioglou is a Handa Fellow at Pacific Forum CSIS. She holds a Masters degree from King's College London War Studies Department.

Matthew Hallex is a graduate of the Security Policy Studies Masters program at George Washington University. He focused on Asian regional security and weapons of mass destruction.

[1] For China's budget, see http://www.globalsecurity.org/military/world/china/budget.htm

[2] For a very brief but enlightening comparison of U.S. and Chinese forces, see http://www.globalsecurity.org/military/world/china/pla-v-us.htm.

[3] James Holmes, "'A 'Fortress Fleet' for China," *Whitehead Journal for Diplomacy and International Relations*, Vol. 11 No. 2, Summer/Fall 2010, p. 24.

[4]Admiral M. McDevitt, 'China's Naval Modernization: Cause for Storm Warnings?," 2010 Pacific Symposium, Institute for National Strategic Studies, National Defense University, June 16, 2011, available at http://www.ndu.edu/inss/docUploaded/PLAN_McDevitt_Remarks.pdf p. 25.

[5] Ronald O'Rourke, "China Naval Modernization: Implications for US Navy Capabilities-Background and Issues for Congress," Congressional Research Service, June 8, 2011, p. 21.

[6] Ibid, p. 16.

[7] When operating on batteries, conventional diesel electric submarines have a stealth advantage over their nuclear counterparts. Conventional submarines are far more vulnerable to detection when recharging their batteries. A submarine equipped with an Air Independent Propulsion (AIP) system can operate for significantly longer without

needing to recharge its batteries.

[8] "The People's Liberation Army Navy, A Modern Navy with Chinese Characteristics," Office of Naval Intelligence, August 2009, p. 20.

[9] "Recent photos from the Chinese shipyards," *Information Dissemination,* September 4, 2011, http://www.informationdissemination.net/2011/04/recent-photos-from-chinese-shipyards.html

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[14] Hans Kristensen, "Chinese Submarine Patrols Doubled in 2008," Federation of American Scientists, February 3, 2009, http://www.fas.org/blog/ssp/2009/02/patrols.php.

[15]Mackenzie Eaglen and Jon Rodeback, "Submarine Arms race in the Pacific: The Chinese Challenge to US Undersea Supremacy," Heritage Foundation, *Backgrounder No. 2367*, February 2, 2010, p. 8.

[16]Ronald O'Rourke, "Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress," Congressional Research Service, April 21, 2011, p 7.

[17] Ronald O'Rourke, "Navy Littoral Combat Ship (LCS) Program: Background, Issues, and Options for Congress," Congressional Research Service, April 29, 2011, pp. 10-12.

[18] "U.S., Swedish Navies Sign Agreement to Bilaterally Train on State-of-the-Art Sub," Press Release, U.S. Navy, March 23, 2005, available at http://www.navy.mil/search/display.asp?story_id=17621.

[19] "DESI: Diesel Electric Submarine Initiative," *Undersea Warfare*, Vol. 8 No. 3, Spring 2006, available at http://www.navy.mil/navydata/cno/n87/usw/issue_30/desi.html.

[20] O'Rourke, June 2011, p. 74.

[21]Dan De Luce, "Gates vows new weapons for US role in Asia," AFP, June 3, 2011, available at http://www.google.com/hostednews/afp/article/ALeqM5iIiwf5bQxPlPw3JZgHucDG40Kjeg?docId=CNG.d2e32a0dd0fd2fcb6d84cd7f4ba7e8ae.c1.

[22] Michael J. Connor, "Investing in the Undersea Future," Proceedings, Vol. 137, No, 7, June 2011.

[23] Owen R. Cote Jr., "Assessing the Undersea Balance Between the U.S. and China," SSP Working Paper, February 2011, available at http://web.mit.edu/ssp/publications/working_papers/Undersea%20Balance%20WP11-1.pdf, p. 12-14.

[24] Gary Schmitt, "U.S. Navy Needs Diesel Submarines," Defense News, June 12, 2011, available at http://www.defensenews.com/story.php?i=6792065.