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THE REBIRTH OF ANTI-SUBMARINE WARFARE

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THE REBIRTH OF ANTI-SUBMARINE WARFARE

Service paper for Director General Naval Force Development

AIM

1. With many Navies rebuilding their submarine fleets, the Royal Canadian Navy (RCN) must refocus training efforts on Anti-Submarine Warfare (ASW) and develop a procurement plan to replace its most effective ASW platform, the Victoria Class Submarine. The Victoria Class submarine's service life is set to expire in the mid 2020s and although there is the possibility of life extension to the mid 2030s, there is currently no project to replace this critical capability.

INTRODUCTION

2. The primary objective of every Navy in the world is to exercise sea control in any area in which it is required to operate. The rejuvenated submarine threat from a number of nations, such as Russia and China, and the decline of the submarine fleet of the United States adds risk to Canadian and Allied warships operating in the vicinity of these countries, whether they work independently or as part of a multi-national coalition. In *Leadmark: The Navy's Strategy for 2020*, the RCN is classified as a "medium global force projection Navy" meaning it may not possess the full range of capabilities.¹ Navies of this size must make important choices about which capabilities to invest in when building their fleet. Possessing a submarine fleet and training ASW needs to be one of the capabilities prioritized by the RCN in order to remain relevant. Bryan Clark of the *Center for Strategic and Budgetary Assessments* classifies submarines as one of the most viable means the United States military uses to gather intelligence

¹ Department of National Defence, *Leadmark: The Navy's Strategy for 2020* (Ottawa: Chief of the Maritime Staff, 2001), 44.

and project power.² The RCN presently does not have a plan to replace its Victoria Class submarine, the only submarine in the fleet, and the RCN's most effective ASW asset. With an average 16-year procurement cycle for major capital projects in Canada, the time to consider replacement concepts is now in order to avoid a capability gap.

3. This paper will discuss the RCN's recent decline relating to its ASW capabilities and highlight that a submarine fleet is critical to reversing this trend. It will outline the importance of the submarine in achieving sea control given the number of nations worldwide that operate submarines. It will focus the decline in United States undersea supremacy and on recent developments within the Russian and Chinese submarine fleets. Emerging technologies and future submarine and ASW capabilities will also be discussed.

DISCUSSION

4. The Victoria Class submarine is expected to remain in service until the mid-2020s. The "Submarine Equipment Life Extension" (SELEX) project is currently in the Identification phase of development, which if eventually approved and funded, would extend the Victoria Class to the mid-2030s.³ This life extension has the potential to include the installation of an air independent propulsion system, which would significantly increase the Victoria Class' capacity to stay submerged for extended periods of time.⁴ Canada's National Shipbuilding Procurement Strategy does not include the construction of a new submarine. If the life extension project is not made a top priority, and if no replacement project is initiated in the next few years, the RCN may soon

² Bryan Clark, "The Emerging Era in Undersea Warfare," *Center for Strategic and Budgetary Assessments*, January 22, 2015. 1.

³ Department of National Defence, "Capability Investment Database," last accessed on the DWAN 14 December 2015, http://cid-bic.forces.mil.ca/CID/Project-Home_e.asp.

⁴ *Ibid.*

be in a position where it loses its submarine capability. To remain a relevant international Navy the RCN's future fleet must include a credible submarine capability.

5. After the end of the Cold War, and the supposed end of an enemy submarine threat, the ASW skills of the RCN and many other Allied Navies have diminished significantly due to a lack of training and legacy equipment. The RCN is planning to upgrade its Halifax Class ASW equipment by pursuing the "Underwater Warfare Suite Upgrade" project, which is currently in the Definition phase. Still a few years from completion, this project is not expected to reach full operational capability until 2024.⁵

6. Dr. Milan Vego, Joint Military Operations professor at the Naval War College, argues that the "political, military, demographic and economic importance of the littorals has steadily increased over the past two decades."⁶ With the shift in focus of Naval operations away from blue water operations and towards the littoral environment, the need for ASW capabilities is critical. Diesel electric (SSK) submarines are extremely effective in the littoral environment and pose a significant threat to carrier battle groups, task groups, amphibious operations, and commercial shipping in an anti-access/area denial (A2AD) role.

7. The United States Navy dominated the underwater warfare domain until the end of the Cold War. However, the United States Navy's fleet of nuclear attack submarines diminished in size by about half from 1987-2009, from 102 to 53 vessels.⁷ According to the *Heritage Foundation*, a conservative think tank in the United States, the United States Navy's submarine

⁵ *Ibid.*

⁶ Vego, Milan, "On Littoral Warfare," *Naval War College Review* 68.2 (Spring 2015).
<http://search.proquest.com/docview/1660144761/fulltext?accountid=9867>

⁷ Mackenzie Eaglen and Jon Rodeback, "Submarine Arms Race in the Pacific: The Chinese Challenge to U.S. Undersea Supremacy," *The Heritage Foundation* No. 2367 (February 2, 2010): 5.
http://s3.amazonaws.com/thf_media/2010/pdf/bg_2367.pdf

fleet will continue to shrink until 2028.⁸ Allied Navies have been able to achieve sea control while ignoring the underwater domain as the United States Navy has provided underwater domination. This luxury afforded to Allied Navies may not be present in the future given the decline in United States underwater assets. It is time for other nations to increase their underwater warfare capability to fill the upcoming capability shortfall. In its 2009 Defence White Paper, Australia committed to doubling the size of its submarine fleet to 12 vessels,⁹ and confirmed this pledge in its 2013 Defence White Paper.¹⁰

8. There are currently forty nations worldwide that operate submarines as part of their naval fleet.¹¹ That number is expected to increase in the near future as China has signed contracts to provide Bangladesh and Pakistan with its Yuan Class SSK. Other rumoured buyers of the Yuan Class include Thailand and Egypt.¹² Larger key nations that are rejuvenating their aging submarine fleets include Russia and China, which will be discussed in greater detail below.

9. Russia has recently replenished its SSK and nuclear submarine fleets. The Varshavyanka Class SSK first entered service in 2013 and once construction is complete Russia will have six Varshavyanka Class submarines in total. The *National Interest* reported in April 2015 that the Varshavyanka Class' homeport would be in the Black Sea, located in Crimea. The Varshvyanka Class was designed for anti-shipping, ASW and is capable of striking underwater, land and surface targets.¹³

⁸ *Ibid.*, 2.

⁹ Department of Defence, *Defending Australia in the Asia Pacific Century: Force 2030*, (Australia, 2009): 70. http://www.defence.gov.au/whitepaper/2009/docs/defence_white_paper_2009.pdf

¹⁰ Department of Defence, *Defence White Paper 2013*, (Australia, 2013): 82. http://www.defence.gov.au/whitepaper/2013/docs/WP_2013_web.pdf

¹¹ Global Firepower, last accessed 8 December 2015, <http://www.globalfirepower.com/navy-submarines.asp>.

¹² Dean Yates, "Exclusive- China trying to undercut Germany on submarine offer to Egypt-sources", *Reuters*, 15 September 2015.

¹³ Zackary Keck, "Russia Launches Quietest Submarine in the World," *National Interest*, 29 April 2015.

10. Russian sources claim their newest nuclear submarine, the Borei Class SSBN, is “the planet’s most advanced nuclear deterrence tool.”¹⁴ It is armed with 16 ballistic missiles, each with a range of 9,000 kilometers. There are presently three operational Borei Class submarines in Russia’s fleet and this number will expand to eight by 2020.¹⁵ According to the *UK Daily Mail*, President Putin is also planning to re-commission a Cold War era fleet of midget submarines, which Russia claims are virtually undetectable. The Piranha Class has a crew of nine and is capable of carrying mines and torpedoes; it can deploy combat divers or up to six Special Forces personnel.¹⁶

11. China has also significantly improved its submarine fleet and it will continue to improve in the future. The *Rand Corporation*, a not for profit research institute in the United States, believes that by 2017 China will have a fleet of 49 submarines, the majority of which will be diesel electric, armed with torpedoes and cruise missiles.¹⁷ The United States Office of Naval Intelligence estimates that China’s submarine fleet will eventually grow to 75 vessels.¹⁸ China’s new SSK, The Yuan Class, is an exceptionally quiet submarine equipped with an air independent propulsion system, allowing it to stay submerged for longer periods than traditional SSKs.¹⁹

¹⁴ *Ibid.*

¹⁵ Navy Recognition, last accessed 8 December 2015, <http://www.navyrecognition.com/index.php/news/defence-news/year-2014-news/december-2014-navy-naval-forces-maritime-industry-technology-security-global-news/2286-vladimir-monomakh-third-borey-class-ssbn-joined-russian-navy.html>.

¹⁶ Darren Boyle, “New threat from Russia as Putin revives Cold War programme of midget “Piranha” submarines that are virtually undetectable,” *Daily Mail Online*, 8 July 2015.

¹⁷ Rand Corporation, “Chinese Threats to U.S. Surface Ships: An Assessment of Relative Capabilities, 1996-2017,” 2015.

¹⁸ Nuclear Threat Initiative, last accessed 8 December 2015, <http://www.nti.org/analysis/articles/china-submarine-capabilities/>.

¹⁹ *Ibid.*

There are currently 12 Yuan Class submarines in China's fleet, and that number is expected to grow to 20.²⁰

12. China currently has four of their nuclear SSBN, the Jin Class, in service²¹ and their fleet is expected to grow to eight by 2020.²² Based on these developments, experts with the *Rand Corporation* believe that the Chinese submarine fleet is a significant threat to United States carrier battle groups operating in the South China Sea. As RCN frigates often integrate into U.S. carrier battle groups as picket ships, they become potential targets. "China has rapidly improved its ability to reliably locate and attack U.S. carrier battle groups at distances up to 2000 kilometers from its coast,"²³ concludes the *Rand Corporation*.

13. There are many developing and emerging technologies in the submarine and ASW fields that will significantly change the landscape of the future environment. Bryan Clark outlines a number of these in his article "The Emerging Era of Undersea Warfare," such as: low frequency active sonar, the use of laser and light emitting diode (LED) for submarine detection, uninhabited underwater vehicles (UUV), submarine launched uninhabited air vehicles (UAV) and defensive underwater battle spaces.²⁴

14. The introduction of low frequency active sonar will greatly increase detection ranges when compared to traditional active acoustic sonars. The RCN's replacement helicopter for the aging Sea Kings, the Cyclone will have low frequency dipping sonar capable of significantly

²⁰ *Ibid.*

²¹ *Ibid.*

²² Richard D. Fisher Jr., and James Hardy, "US upgrades assessment of China's Type 094 SSBN fleet," *Janes*, 19 April 2015, <http://www.janes.com/article/50761/us-upgrades-assessment-of-china-s-type-094-ssbn-fleet>.

²³ Rand Corporation, "Chinese Threats to U.S. Surface Ships: An Assessment of Relative Capabilities 1996-2017," 2015, 1.

²⁴ Bryan Clark, "The Emerging Era in Undersea Warfare," *Center for Strategic and Budgetary Assessments*, January 22, 2015, 10.

extended detection ranges. Advances in laser and LED technologies in detecting submarines have the potential to revolutionize active detection, especially if they do not reveal the position of the emitting platform and if detection ranges are significantly increased. Clark argues that increased detection ranges could allow warships to attack an enemy submarine at much greater distances, eliminating the need for lengthy, asset intensive tracking, by using theoretical missile-launched torpedoes to deter enemy submarine activity.²⁵

15. The *Washington Times* reported in September of 2015 that Russia is developing an autonomous UUV designed to launch nuclear weapons, a capability that appears to be much more offensive in nature than the other components of its submarine fleet.²⁶ The same article also points out that the United States Navy is developing its own weapons-carrying UUV. Clark believes that UUV endurance will increase to one to two months over the next few years using a combination of traditional propulsion, batteries, and fuel cells.²⁷ Some submarines are capable of launching small UAVs for surveillance, electronic warfare information gathering and targeting purposes, but they are small and of short endurance.²⁸ Many experts in the field believe that submarine and UUV launched UAVs with longer endurance will soon be developed and they may also come equipped with a strike capability.²⁹

16. Clark also envisions the creation of defensive underwater battle spaces, which include harbour or shoreline infrastructure to actively or passively detect enemy submarines. This

²⁵ *Ibid.*, 10.

²⁶ Bill Gertz, "Russian drone submarine would threaten U.S. coast; nuclear vessel in development," *Washington Times*, 8 September 2015.

²⁷ Bryan Clark, "The Emerging Era in Undersea Warfare," *Center for Strategic and Budgetary Assessments*, January 22, 2015, 10.

²⁸ *Ibid.*, 13.

²⁹ Bryan Clark, "The Emerging Era in Undersea Warfare," *Center for Strategic and Budgetary Assessments*, January 22, 2015, 10, and Owen R. Cote Jr., *How Will New Submarine Sensors and Payloads Influence Naval Warfare in the 21st Century?* (Cambridge: MIT Security Studies Program, 4 June 2012).

tracking information would be sent to a land based command and control (C2) center that would have the ability to launch ballistic or cruise missiles with torpedo warheads. He believes that these missile launched torpedoes would not likely have the accuracy to destroy the detected enemy submarine but would be effective in deterring the threat, leaving the local surface and shore-based assets safe.³⁰ This ASW tracking and C2 infrastructure concept could be utilized in Canada's Northwest Passage to track shipping or for underwater platform detection.

17. At the 2015 *International Bhurban Conference on Applied Science and Technology*, Imran Khan and his team presented their hybrid submarine concept design. They proposed a submarine with a fully electric propulsion system combining a nuclear power station and rechargeable air independent propulsion, giving this platform the endurance of a nuclear submarine and the stealth of an SSK. An important point here for the RCN is the belief that given the size reduction and technological advancements of ASW sensors, this technology can be procured at a low cost and in a small submarine, similar in size to the Victoria class.³¹ In addition to improved ASW capabilities, this type of hybrid submarine would significantly increase the RCN's ability to patrol Canada's arctic.

CONCLUSION

18. The re-emergence of submarine threats around the world poses significant risks to the RCN whenever it deploys overseas as a Canadian Task Force, as part of an international coalition or as an independent ship. Given the declining ASW skills of the RCN, the decline in

³⁰ Bryan Clark, "The Emerging Era in Undersea Warfare," *Center for Strategic and Budgetary Assessments*, January 22, 2015, 16.

³¹ Imran Khan, Simon Harrison, Daniel Patten and Asif Raza, "Low Cost Hybrid Propulsion Submarine Concept Design," *Proceedings of 2015 12th International Bhurban Conference on Applied Sciences & Technology*, Islamabad, Pakistan (January 2015): 518. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7058549>

United States Navy submarines and the rejuvenation of the Russian and Chinese submarine fleets, RCN vessels are at risk whenever entering the western Pacific Ocean, the Arctic Ocean, the Baltic Sea, the Black Sea, the South China Sea and the East China Sea.

19. The RCN is taking steps to improve the ASW equipment on the Halifax Class frigates. The RCN needs to ensure this will lead to an increased focus on training and proficiency of her crews. The most important ASW asset in the RCN has been relatively ignored, as the National Shipbuilding Procurement Strategy does not include the construction of new submarines. An underwater asset, manned or unmanned, to replace the Victoria Class submarine is critical to the viability of the future RCN fleet.

20. There are numerous future technologies that will change the landscape of underwater warfare. Submarine launched UAVs and UUVs in particular, could be used to force multiply the RCN's fleet at a potentially lower cost than traditional manned submarines. UAVs are being successfully used onboard RCN frigates that do not have an embarked helicopter, or are being used in conjunction with helicopters to extend the Ship's airborne surveillance time. The continued development of UUVs for surveillance, torpedo delivery and other roles traditionally carried out by manned submarines could see this capability available for purchase at a price significantly less than a manned replacement. Unmanned platforms also include the added benefit of keeping RCN personnel out of harm's way.

RECOMMENDATION

21. Based on the current trajectory of the RCN submarine fleet and the emerging submarine threat posed by nations such as Russia and China, the following recommendations will mitigate the risks for the RCN:

- a. The RCN and Allied Navies should return their focus to ASW training to re-establish themselves as world leaders,
- b. The RCN should make the SELEX project and the development and procurement of a replacement project for the Victoria Class submarine a top priority,
- c. The RCN should monitor developments in the UUV field as a possible add-on or force multiplier to a Victoria Class replacement project.

BIBLIOGRAPHY

- Australia. Department of Defence. *Defending Australia in the Asia Pacific Century: Force 2030*. Australia, 2009.
http://www.defence.gov.au/whitepaper/2009/docs/defence_white_paper_2009.pdf
- Australia. Department of Defence. *Defence White Paper 2013*. Australia, 2013.
http://www.defence.gov.au/whitepaper/2013/docs/WP_2013_web.pdf
- Boyle, Darren. "New threat from Russia as Putin revives Cold War programme of midget "Piranha" submarines that are virtually undetectable." *Daily Mail Online*. 8 July 2015.
<http://www.dailymail.co.uk/news/article-3153048/New-threat-Russia-Putin-revives-Cold-War-programme-midget-Piranha-submarines-virtually-undetectable.html>
- Canada. Department of National Defence. "Capability Investment Database." Last accessed on the DWAN 14 December 2015. http://cid-bic.forces.mil.ca/cid/intro_e.asp
- Canada. Department of National Defence. *Leadmark: The Navy's Strategy for 2020*. Ottawa: Chief of the Maritime Staff, 2001.
- Canada. Department of National Defence. *Securing Canada's Ocean Frontiers: Charting the Course from Leadmark*. Ottawa: Chief of the Maritime Staff, 2005.
- Canadian Forces College. *MCP 1 Naval Doctrine Manual*. Toronto: Canadian Forces College, 2006.
- Clark, Bryan. "The Emerging Era in Undersea Warfare." *Center for Strategic and Budgetary Assessments*. January 22, 2015.
- Cote, Owen R., Jr. *How Will New Submarine Sensors and Payloads Influence Naval Warfare in the 21st Century?* Cambridge: MIT Security Studies Program, 4 June 2012.
- Eaglen, Mackenzie and Jon Rodeback. "Submarine Arms Race in the Pacific: The Chinese Challenge to U.S. Undersea Supremacy." *The Heritage Foundation*. No. 2367, February 2, 2010. http://s3.amazonaws.com/thf_media/2010/pdf/bg_2367.pdf
- Fisher, Richard D., Jr. and James Hardy. "US upgrades assessment of China's Type 094 SSBN fleet." *Janes*. 19 April 2015. <http://www.janes.com/article/50761/us-upgrades-assessment-of-china-s-type-094-ssbn-fleet>
- Friedman, Norman, James S. O'Brasky, and Sam J. Tangredi. "Globalization and Surface Warfare." In *Globalization and Maritime Power*, edited by Sam J. Tangredi. Washington, DC: Institute for National Strategic Studies, 2002.
- Gertz, Bill. "Russian drone submarine would threaten U.S. coast; nuclear vessel in development." *Washington Times*. 8 September 2015.

<http://www.washingtontimes.com/news/2015/sep/8/russian-drone-submarine-would-threaten-us-coast/?page=all>

Global Firepower, last accessed 8 December 2015. <http://www.globalfirepower.com/navy-submarines.asp>

Keck, Zackary. "Russia Launches Quietest Submarine in the World." *National Interest*. 29 April 2015. <http://nationalinterest.org/blog/the-buzz/russia-launches-quietest-submarine-the-world-12765>

Khan, Imran, Simon Harrison, Daniel Patten and Asif Raza. "Low Cost Hybrid Propulsion Submarine Concept Design." *Proceedings of 2015 12th International Bhurban Conference on Applied Sciences & Technology*. Islamabad, Pakistan. (January 2015): 503-518. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7058549>

Krepinevich, Andrew F. "Maritime Competition in a Mature Precision-Strike Regime." *Center for Strategic and Budgetary Assessments*. April 13, 2015.

Navy Recognition. Last accessed 8 December 2015. <http://www.navyrecognition.com/index.php/news/defence-news/year-2014-news/december-2014-navy-naval-forces-maritime-industry-technology-security-global-news/2286-vladimir-monomakh-third-borey-class-ssbn-joined-russian-navy.html>

Nuclear Threat Initiative. Last accessed 8 December 2015. <http://www.nti.org/analysis/articles/china-submarine-capabilities/>

Psallidas, Konstantinos, Clifford A. Whitcomb, and John C. Hootman. *Design of Conventional Submarines with Advanced Air Independent Propulsion Systems and Determination of Corresponding Theater-Level Impacts*. Cambridge, MA: Massachusetts Institute of Technology, 2010.

Rand Corporation. "Chinese Threats to U.S. Surface Ships: An Assessment of Relative Capabilities, 1996-2017." 2015. http://www.rand.org/content/dam/rand/pubs/research_briefs/RB9800/RB9858z4/RAND_RB9858z4.pdf

Vego, Milan. "On Littoral Warfare." *Naval War College Review*. 68.2 (Spring 2015): 30-68. <http://search.proquest.com/docview/1660144761/fulltext?accountid=9867>

Yates, Dean. "Exclusive- China trying to undercut Germany on submarine offer to Egypt-sources." *Reuters*. 15 September 2015. <http://www.reuters.com/article/china-egypt-submarines-idUSL4N11J0OS20150915#Lc8J0Vw7iU6r2I7R.97>