11-30-2023

China Maritime Report No. 33: China's Sea-Based Nuclear Deterrent: Organizational, Operational, and Strategic Implications

David C. Logan

中国海事研究所
China Maritime Studies Institute

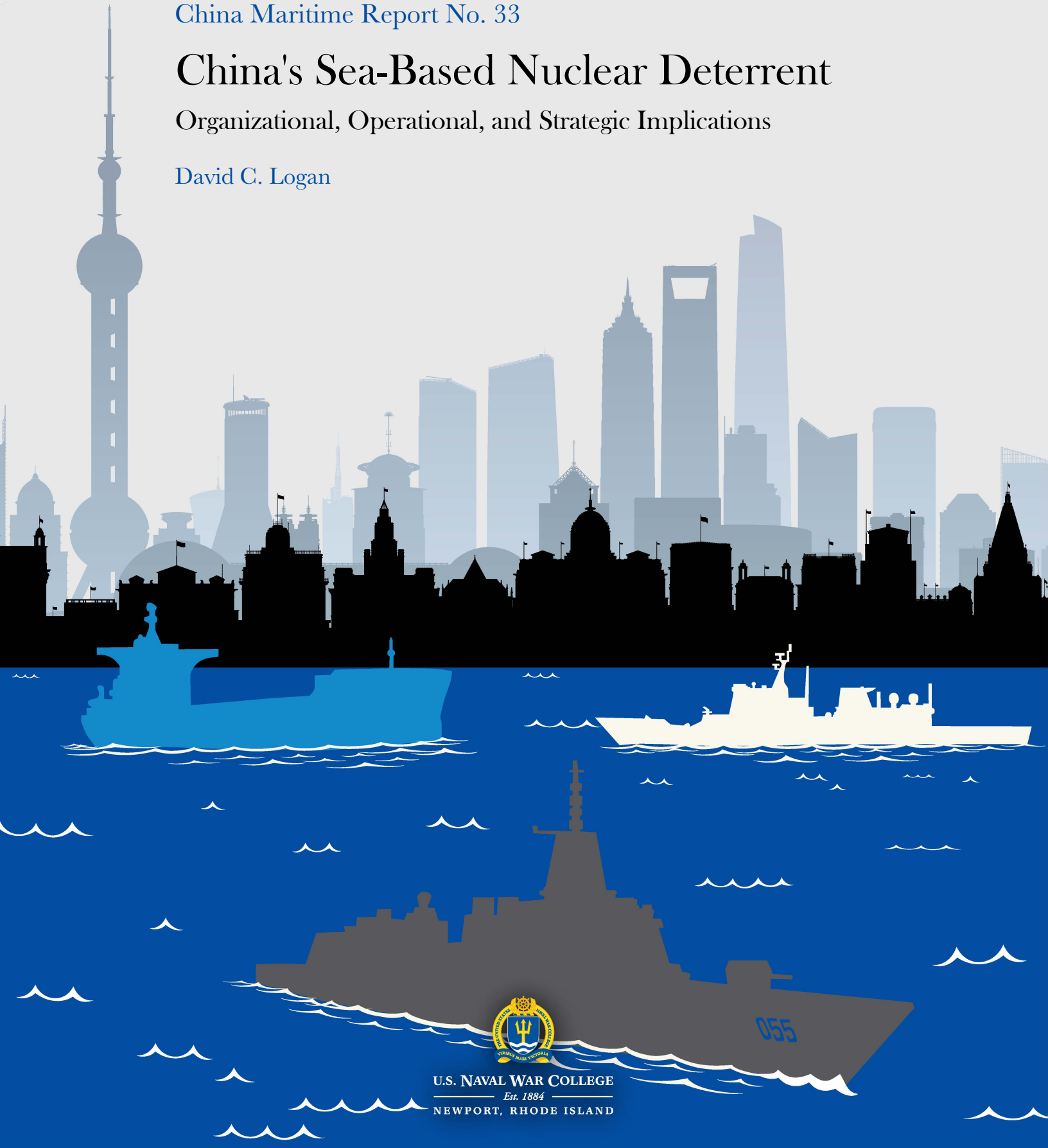
December 2023

China Maritime Report No. 33

China's Sea-Based Nuclear Deterrent

Organizational, Operational, and Strategic Implications

David C. Logan



U.S. NAVAL WAR COLLEGE
Est. 1884
NEWPORT, RHODE ISLAND

Summary

China's development of a credible sea-based deterrent has important implications for the PLAN, for China's nuclear strategy, and for U.S.-China strategic stability. For the PLAN, the need to protect the SSBN force may divert resources away from other missions; it may also provide justification for further expansion of the PLAN fleet size. For China's nuclear strategy and operations, the SSBN force may increase operational and bureaucratic pressures for adopting a more forward-leaning nuclear strategy. For U.S.-China strategic stability, the SSBN force will have complex effects, decreasing risks that Chinese decisionmakers confront use-or-lose escalation pressures, making China less susceptible to U.S. nuclear threats and intimidation and therefore perceiving lower costs to conventional aggression, and potentially introducing escalation risks from conventional-nuclear entanglement to the maritime domain.

Introduction

China is undertaking a significant nuclear expansion and modernization. While China's nuclear warhead stockpile numbered fewer than 300 bombs just a few years ago, the Department of Defense estimates that by 2030 the "the PRC will have about 1,000 operational nuclear warheads, most of which will be fielded on systems capable of ranging the continental United States (CONUS)" and could have as many as 1,500 warheads by 2035."[1] While the changes within the People's Liberation Army (PLA) Rocket Force (PLARF) have received significant attention, the development of a credible fleet of nuclear-powered ballistic missile submarines (SSBNs) will also have important implications for China's nuclear strategy and operations, the PLA Navy (PLAN), and U.S.-China strategic stability. Given the deterioration of U.S.-China relations, growing competition in the nuclear domain, and the prominence of the maritime domain to any future U.S.-China crisis or conflict, China's SSBN force will assume greater importance. This report examines these developments and their implications.

China's development of its first credible sea-based nuclear deterrent has several implications for China's naval force structure and strategy, Chinese nuclear strategy and operations, and U.S.-China strategic stability. For the PLAN, a sea-based nuclear deterrent will likely impose new demands on the rest of the navy by requiring the service to dedicate other forces to the defense of SSBNs and may require the PLAN to develop personnel reliability and warhead handling programs, which could lead to changes from its historically centralized approach to nuclear weapons. For China's nuclear strategy and operations, the realization of a full nuclear triad may lead the PLA to construct bodies and processes for maintaining real-time awareness of the status of China's nuclear deterrent, and for targeting coordination and deconfliction among the nuclear capabilities of the PLARF, the Navy and the Air Force. The SSBN force may also require the establishment and empowerment of additional nuclear constituencies within the PLA, which might advocate for a greater role for nuclear weapons in China's national security strategy, while the operational requirements of an SSBN force may

[1] *Military and Security Developments Involving the People's Republic of China 2022*, Office of the Secretary of Defense, November 2022, pp. 97-98, https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF. China's nuclear forces will undoubtedly grow, though past analyses have regularly overestimated future Chinese warhead growth. See Hans Kristensen, "DIA Estimates for Chinese Nuclear Warheads," Federation of American Scientists, Strategic Security, May 31, 2019, https://fas.org/blogs/security/2019/05/chinese-nuclear-stockpile. For additional estimates of the size and composition of China's future nuclear forces, see *China's Emergence as a Second Nuclear Peer: Implications for U.S. Nuclear Deterrence Strategy* (Livermore, CA: Lawrence Livermore National Laboratory, 2023), pp. 15-16; and Phillip C. Saunders, "Baseline Estimate of Chinese Nuclear Force, 2030-2036," Paper prepared for CGSR Workshop on "Facing the Coming Arms Control Interregnum," August 9-10, 2022, Lawrence Livermore National Laboratory.

encourage China to reconsider some of its longstanding nuclear weapons practices. Finally, for U.S.-China strategic stability, the development of a credible sea-based deterrent, to the extent it strengthens Chinese decisionmakers' confidence in the survivability of the country's nuclear deterrent, may strengthen some forms of crisis stability while weakening others, provide Beijing the option to use its stronger nuclear forces as a shield behind which to initiate conventional aggression, and introduce new forms of inadvertent escalation stemming from conventional-nuclear "entanglement."

This report draw on a wide-range of sources.[2] It prioritize sources traditionally viewed as authoritative, including China's Defense White Papers, high-level curricular materials published by PLA research institutions, such as the *Science of Military Strategy* volumes published by the Academy of Military Science and National Defense University, and academic writings published by researchers affiliated with PLA institutions, including both the PLAN Submarine Academy and the Rocket Force Engineering University.[3] This report also reviews articles appearing in major Chinese-language venues, particularly those published by influential think tanks and research centers.[4] This report examines military reporting and commentary as well as secondary sources discussing Chinese views of strategic stability. Finally, it draws on U.S. sources, including unclassified U.S. intelligence estimates and public assessments from the Department of Defense, as well as public statements from senior U.S. military officials. One caveat on any open-source analysis of Chinese nuclear views is the limits created by the historical division between China's strategic community, consisting of researchers and strategists at civilian and PLA-affiliated institutions, and the operator community, consisting of the military professionals in the PLA and, specifically, the missile forces charged with operating the country's nuclear missiles.[5] The views of the strategic community are more accessible than those of operators. However, as of the early 2000s, there were signs of greater interaction between these two communities, including strategists briefing operators, operators pursuing Ph.Ds. at civilian institutions, and participation by operators in Track-1.5 dialogues with American colleagues.[6]

---

[2] This paragraph is, in part, reproduced from David C. Logan, "Chinese Views of Strategic Stability," Paper prepared for the Los Alamos National Laboratory Director's Strategic Resilience Initiative workshop on "PLA Actions and Behavior in a Crisis," July 16-17, 2022.

[3] For discussions of evaluating authoritativeness in Chinese sources, see Paul H.B. Goodwin and Alice L. Miller, *China's Forbearance Has Limits: Chinese Threat and Retaliation Signaling and Its Implications for a Sino-American Military Confrontation* (Washington, D.C.: Center for the Study of Chinese Military Affairs, National Defense University, 2013), pp. 30-33; and Alison A. Kaufman and Daniel M. Hartnett, *Managing Conflict: Examining Recent PLA Writings on Escalation Control* (Arlington, VA: Center for Naval Analyses, 2016), pp. 3-4.

[4] These include, among others, *Modern Ships* (现代舰船), published by China Ship Information Center; *World Economics and Politics* (世界经济与政治), published by the Institute of World Economics and Politics at the Chinese Academy of Social Sciences; *The Chinese Journal of American Studies* (美国研究], published by the Institute of American Studies at the Chinese Academy of Social Sciences; and *Foreign Affairs Review* (外交评论), published by China Foreign Affairs University.

[5] Li Bin, "Promoting Effective China-U.S. Strategic Nuclear Dialogue," Carnegie Endowment for International Peace, 18 October 2011, https://carnegieendowment.org/2011/10/18/promoting-effective-china-u.s.-strategic-nuclear-dialogue-pub-45743; Gregory Kulacki, "Chickens Talking With Ducks: The U.S.-Chinese Nuclear Dialogue," *Arms Control Today*, October 2011; and author's interviews in Beijing, 2018 and 2019.

[6] Bin, "Promoting Effective China-U.S. Strategic Nuclear Dialogue"; and David Santoro and Robert Gromoll, "On the Value of Nuclear Dialogue with China: A Review and Assessment of the Track 1.5 'China-US Strategic Nuclear Dynamics Dialogue,'" *Issues & Insights*, vol. 20, no. 1 (November 2020), pp. 3-4.

The report proceeds in five parts. First, it summarizes key features of China's SSBN force, including recent developments, technical capabilities, and operational practices. Second, it reviews potential implications of the SSBN force for the PLAN, including naval force development and force allocation. Third, it assesses implications for China's nuclear strategy and operations, including the unique role of the SSBN force within China's nuclear deterrent and the pressures the force may create for China to change its nuclear operations and strategy. Fourth, it reviews implications of the SSBN force for U.S.-China strategic stability. Finally, it concludes with a discussion of implications for U.S. policy and future research on China's nuclear forces.

China's SSBN Force: Capabilities and Operations

The PLAN operates six SSBNs, including both Type 094 and Type 094A vessels.[7] Chinese media reports and statements from senior U.S. military officials indicate that the PLAN may build at least two more vessels.[8] Each SSBN is equipped to carry up to 12 SLBMs. Early Type 094 vessels could only be equipped with the shorter-range JL-2, which is believed to have a range of approximately 7,200 kilometers.[9] With this range, PLAN SSBNs operating from waters near China would be able to target Guam, Alaska, and Hawaii, as well as targets in India and western Russia, but would be unable to target the continental United States. Recent reports and public assessments from the U.S. Department of Defense indicate that the Type 094A vessels can carry the latest generation JL-3 SLBM, which may have a range of over 10,000 kilometers, allowing them to strike the continental United States without leaving Chinese waters.[10] China's JL-2 SLBMs are reportedly equipped with a single warhead and possibly penetration aids, though unclassified U.S. intelligence estimates say that the JL-3 will be capable of launching multiple warheads.[11]

The PLAN's earliest SSBNs were very noisy, raising questions about their survivability, though recent reports suggest that newer SSBNs may be significantly quieter.[12] As China began to operate its Type 094 vessels, the U.S. Office of Naval Intelligence assessed that the SSBN was louder than the Soviet Akula I SSNs, which were first fielded in the early 1980s, and that the *Kilo* submarines purchased from Russia are the quietest in the entire PLA Navy.[13] However, according to Chinese media, the Type 094A incorporates several design changes which have enhanced the vessel's

---

[7] *Annual Report to Congress: The Military Power of the People's Republic of China 2022*, Office of the Secretary of Defense, November 2022, pp. 52-53, https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF; and Hans M. Kristensen and Matt Korda, "Chinese Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists*, vol. 77, no. 6 (2021), p. 329.

[8] Minnie Chan, "China's New Nuclear Submarine Missiles Expand Range in US: Analysts," *South China Morning Post*, 2 May 2021, www.scmp.com/news/china/military/article/3131873/chinas-new-nuclear-submarine-missiles-expand-range-us-analysts; and Samuel J. Locklear, U.S. Pacific Command and U.S. Forces Korea, Hearing Before the Senate Armed Services Committee, 113th Congress, 16 April 2015, p. 9, https://www.armed-services.senate.gov/imo/media/doc/Locklear_04-16-15.pdf.

[9] Kristensen and Korda, "Chinese Nuclear Weapons, 2021," pp. 320 and 329.

[10] *Annual Report to Congress: The Military Power of the People's Republic of China 2022*, p. 94.

[11] Ibid., p. 96; and *Ballistic and Cruise Missile Threat*, p. 33.

[12] Minnie Chan, "China Raises Nuclear Submarine Stealth Game with Redesign and Tactics to 'Hide ID Numbers,'" *South China Morning Post*, 9 October 2021, https://www.scmp.com/news/china/military/article/3151686/china-raises-nuclear-submarine-stealth-game-redesign-and; Chan, "China's New Nuclear Submarine Missiles Expand Range in US: Analysts"; and 凌云 [Ling Yun], 2018 南海大阅兵 ["2018 South China Sea Military Parade"], 兵器知识 [*Ordnance Knowledge*], no. 7 (2018), pp. 19-20.

[13] "The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics," U.S. Office of Naval Intelligence, August 2009, p. 22, https://apps.dtic.mil/sti/pdfs/ADA510041.pdf.

quietness.[14] These include removing the porthole on the command enclosure, adopting a fillet structure at the connection between the command enclosure and the hull, and "incorporating reactors with natural circulation capabilities, floating raft vibration reduction, and anechoic tiles."[15]

The Defense Department reports that China is already conducting "continuous at-sea deterrence patrols" with its SSBNs.[16] Analysts have debated whether China will deploy its SSBNs in bastions close to China's shores or disperse them on open ocean patrols; both approaches have distinct strengths and weaknesses.[17] If China adopts a bastion strategy, it might operate its SSBNs in the Bohai Gulf, the Yellow Sea, and northern parts of the South China Sea, shielding them behind China's conventional military forces (researchers largely believe that the South China Sea would be the prime candidate for a bastion given the shallow depths, busy maritime traffic, and lower temperature and salinity of the Yellow Sea, all of which complicate SSBN operations and facilitate anti-submarine warfare [ASW] efforts).[18] A bastion strategy would reduce the operational demands on China's SSBN force, minimize interactions with adversary naval assets, and eliminate the need to transit the first island chain. However, a bastion strategy may also require China to divert more of its military forces to defending the SSBN fleet and would negate the ability of SSBNs to launch from south of the United States to avoid U.S. BMD capabilities. Moreover, Type 094 vessels equipped with the shorter-range JL-2 SLBM would be unable to strike the continental United States from a bastion near China (Type 094A SSBNs equipped with the longer-range JL-3 SLBM would be able to strike the west coast of the United States from a bastion).[19]

---

[14] Chan, "China's New Nuclear Submarine Missiles Expand Range in US: Analysts." These design changes were led by Rear Admiral Ma Weiming, who has taken charge of efforts to develop new propulsion technology. Ma, who received a Ph.D. in electrical engineering from Tsinghua University, has served as Director of the Institute of Power Electronic Technique Application at the Naval University of Engineering. In 2019, he was selected as a member of the Central Committee. See Minnie Chan, "The Top Engineer with the Key to China's Dream of Having the World's Most Powerful Navy," *South China Morning Post*, 5 July 2017, https://www.scmp.com/news/china/diplomacy-defence/article/2099006/top-engineer-key-chinas-dream-having-worlds-most; and Chen Zhuo, "Naval Tech Professor Becomes Full CPC Central Committee Member," *China Military Online*, 1 November 2019, http://eng.chinamil.com.cn/CHINA_209163/TopStories_209189/9666249.html.

[15] Ling, "2018 South China Sea Military Parade." p. 19.

[16] *Annual Report to Congress: The Military Power of the People's Republic of China 2022*, p. 94.

[17] See, for example, 胡高辰 [Hu Gaochen], 中美不对称核稳定与美国战略机会主义论析 ["Analysis of Sino-U.S. Asymmetric Nuclear Stability and U.S. Strategic Opportunism"], 国际安全研究 [*Journal of International Security Studies*], no. 2 (2021), p. 79; 田剑威 [Tian Jianwei], 094 型核潜艇—中国 "南海之王" ["Type-094 Nuclear Submarine: China's 'King of the South China Sea'"], 共产主义者 [*Communists*], no. 8 (2014), pp. 60-61; Owen R. Cote, *Assessing the Undersea Balance Between the U.S. and China*, Security Studies Program Working Paper (Cambridge, MA: Massachusetts Institute of Technology), pp. 4-11; 吴日强 [Wu Riqiang], 中国战略核潜艇开始战备巡航了吗? ["Have China's Strategic Submarines Begun Patrolling?"], 现代舰船 [*Modern Ships*], no. 1B (2016), p. 33. For a good overview of the ways in which China might operate SSBN bastions, see Tom Stefanick, "Undersea Nuclear Forces: Survivability of Chinese, Russian, and U.S. SSBNs," 9 April 2023, unpublished manuscript.

[18] Toshi Yoshihara, "U.S. Ballistic Missile Defense and China's Undersea Nuclear Deterrent: A Preliminary Assessment," in Andrew S. Erickson, Lyle J. Goldstein, William S. Murray, and Andrew R. Wilson, eds., *China's Future Nuclear Submarine Force* (Annapolis, MD: Naval Institute Press, 2007), p. 340; Tian, "Type-094 Nuclear Submarine: China's 'King of the South China Sea,'" pp. 60-61; and Tong Zhao, "China's Sea-Based Nuclear Deterrent," Carnegie-Tsinghua Center for Global Policy, 30 June 2016, http://carnegietsinghua.org/publications/?fa=63909; and Brendan Rittenhouse Green and Caitlin Talmadge, "Then What? Assessing the Military Implications of Chinese Control of Taiwan," *International Security*, vol. 47, no. 1 (2022), pp. 39-42. Some experts have apparently argued that the Bohai Sea may not be sufficiently deep to permit SSBN operations. Some references also mention the possibility of SSBNs operating in the Arctic.

[19] Green and Talmadge, "Then What? Assessing the Military Implications of Chinese Control of Taiwan," pp. 39-40.

In an open ocean strategy, Chinese SSBNs would have to transit from their home ports through the maritime chokepoints in the first island chain.[20] Once the vessels reach the western Pacific, some Chinese strategists believe they would be much harder to detect in the open ocean.[21] This strategy would likely increase the exposure of SSBNs to adversary military forces and would place greater operational demands on the SSBN force, which could no longer rely on communication systems on or near Chinese soil.[22] While it might require other PLAN forces to escort SSBNs through maritime chokepoints in the first island chain, it is possible that fewer forces would be diverted overall, especially once SSBNs reach the western Pacific. An open ocean strategy would also permit SSBNs to launch on trajectories that avoid U.S. BMD systems. Chinese writers seem to believe that China's ultimate goal is to adopt an open ocean strategy, though some raise concerns about the ability of even the quietest vessels to successfully pass through the first island chain undetected.[23]

Chinese strategists remain concerned about the survivability of the SSBN force, especially against U.S. ASW capabilities.[24] These concerns include not only traditional airborne and surface vessel ASW capabilities in the U.S. Navy, but also those provided by possible hydroacoustic arrays pre-positioned along and within the first island chain, as well as ASW capabilities of other states in the region.[25] Despite the PLAN's recent growth and its new status as the world's largest fleet, Chinese strategists believe that the U.S. Navy could effectively track Chinese SSBNs, especially if it is able to use the assets of other regional states such as Japan and Australia.[26] One Chinese assessment concluded that "Of China's [four] Type 094 boats, generally only one can go to sea, while the rest are used for maintenance and training. Therefore, the United States has a sufficient number of nuclear

[20] Ibid.; Yoshihara, "U.S. Ballistic Missile Defense and China's Undersea Nuclear Deterrent: A Preliminary Assessment," pp. 330-358; and 吴日强 [Wu Riqiang], 中美如何避免核军备竞赛 ["How the U.S. and China Can Avoid a Nuclear Arms Race"], 当代美国评论 [*Contemporary American Review*], no. 2 (2017), pp. 53 and 58.

[21] Tong Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability* (Washington, D.C.: Carnegie Endowment for International Peace, 2018), pp. 28-30. Though the relative stealth and survivability of the vessels would depend on several variables, including local hydrographic conditions, adversary ASW capabilities, maritime geography, and nearby ship traffic. I thank Robert C. Watts IV for this point.

[22] Andrew S. Erickson and Michael Chase, "An Undersea Deterrent?" *Proceedings*, vol. 135, no. 6 (June 2009), p. 40; and Wu, "Have China's Strategic Submarines Begun Patrolling?," pp. 32-33.

[23] For predictions of an open ocean deployment, see 胡锦洋 [Hu Jinyang], "巨浪"席卷西太平洋 ["The 'Julang' Sweeping Through West Pacific Ocean"], 航空知识 [*Aeronautical Knowledge*], no. 1 (2014), pp. 49-51; 文涛 [Wen Tao],中国核潜艇如何有效威慑美国 ["How China's Nuclear Submarines Can Effectively Deter the United States"], 现代舰船 [*Modern Ships*], no. 19 (2015), pp. 30-42; and Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, p. 28. For concerns about passing through the first island chain, see Wu, "How the U.S. and China Can Avoid a Nuclear Arms Race," pp. 53 and 58.

[24] See, for example, 刘震 [Liu Zhen], 对核潜艇保持隐蔽性的支援掩护保障需求分析 ["Analysis of Requirements for Cover Support for Concealment of Nuclear Submarine"], 数字海洋与水下攻防 [*Digital Ocean and Underwater Warfare*], vol. 4, no. 5 (2021), pp. 362-365.

[25] Wu, "How the U.S. and China Can Avoid a Nuclear Arms Race," p. 55; 阳艳竹 [Yang Yanzhu], 刘翠海 [Liu Cuihai], and 黄锐 [Huang Rui], 潜艇隐蔽通信措施分析 ["Analysis of Submarine Concealment Communication Measures"], 数字技术与应用 [*Digital Technology & Application*], vol. 37, no. 2 (2019), pp. 19-20; and Green and Talmadge, "Then What? Assessing the Military Implications of Chinese Control of Taiwan," p. 39-42.

[26] Yang, Liu, and Huang, "Analysis of Submarine Concealment Communication Measures," p. 19; and 肖天亮 [Xiao Tianliang], ed., 战略学 [*Science of Military Strategy*] (Beijing: National Defense University Press, 2020), p. 159.

attack submarines to ensure continuous tracking of each Type 094 boat on a deterrence patrol in peacetime."[27]

Experts on submarine communication at the PLAN Submarine Academy warn, "At this stage, the acquisition probability of the VHF [very high frequency] channel by various military powers has reached 100 percent. The U.S. military alone has set up more than 20 fixed technical reconnaissance stations and direction-finding stations in the Western Pacific region, deploying them in Japan, South Korea, Guam, the Philippines, Thailand and elsewhere."[28] To limit submarine exposure, they advise using burst communication methods, resorting to signal modulation technology, and adapting the communication method, timing, and content of messages to the circumstances, writing that, "At this stage, a single submarine covert communication technology can no longer meet the requirements of anti-reconnaissance and anti-interception of submarine communication. It is necessary to comprehensively use various technical means to reduce the transmission power under the premise of satisfying the reliability and limitation of communication."[29] Other PLA researchers have emphasized flexibility and deception in communicating with submarines: "For example, [China should] establish a communication network based on mobile platforms such as shore-based communication stations, surface ships, conventional submarines, satellites, and unmanned equipment, simulate nuclear submarine communication, and randomly release some false information to contain enemy communication and reconnaissance forces."[30] Joint assessments conducted by researchers from the PLAN Submarine Academy and the Rocket Force Equipment Research Institute call for PLAN SSBNs to operate at a depth of at least 50 meters in order to minimize the possibility of detection, particularly when preparing to launch an SLBM.[31]

Researchers at the PLAN Submarine Academy have also emphasized the need to maximize the amount of time that SSBNs spend conducting deterrence patrols.[32] The researchers argue that there are four traditional methods for enhancing deterrent patrols—increasing the number of SSBNs in operation, increasing the time each vessel spends at sea, decreasing the time spent transiting to the operational area, and implementing land-based crew rotation—but none of these are suitable for China. According to the researchers, increasing SSBN fleet size would entail significant economic and political costs, increasing time at sea places serious demands on equipment and crew, decreasing the time to operational areas is only possible if the vessels are equipped with longer-range missiles, and land-based crew rotation does nothing to decrease transit time which, from a deterrence perspective is "wasted" time at sea. Instead, the researchers argue for exploring rotation of crews while SSBNs are deployed on the open ocean, through the use of "ocean-going support ships, transforming dock landing ships, and submarine support ships. These support forces can provide oil, water, electricity, spare parts, weapons, and other supplies to anchored or alongside submarines in

[27] Wu, "How the U.S. and China Can Avoid a Nuclear Arms Race," pp. 54-55.

[28] Yang, Liu, and Huang, "Analysis of Submarine Concealment Communication Measures," p. 19.

[29] Ibid., p. 20.

[30] Liu, "Analysis of Requirements for Cover Support for Concealment of Nuclear Submarine," p. 364.

[31] 杨继锋 [Yang Jifeng], 刘丙杰 [Liu Bingjie], 陈捷 [Chen Jie], and 黄路炜 [Huang Luwei], 潜射弹道导弹水下大深度发射技术途径分析 ["Research on Underwater Large Depth Launching Technology of Submarine Launched Ballistic Missile"], 兵器装备工程学报 [*Journal of Ordnance Equipment Engineering*], vol. 41, no. 6 (2020), pp. 32-36.

[32] 李建林 [Li Jianlin], 王瑞臣 [Wang Ruichen], and 徐利明 [Xu Liming], 外军潜艇轮换及启示 ["Enlightenment of Foreign Submarine Alternation"], 舰船电子工程 [*Ship Electronic Engineering*], vol. 39, no. 9 (2019), pp. 4-7.

the open sea, and can also carry out on-site maintenance of most base-level maintenance content, providing health and life support for submariners."[33]

Implications of the SSBN Force for the PLAN

The development of China's SSBN force will have several implications for the rest of the PLAN. First, the SSBN force will likely impose new demands on other elements of the fleet. Regardless of whether the PLAN adopts a bastion or an open ocean strategy for its SSBN force, it will have to dedicate other naval forces to the defense of SSBNs.[34] Researchers at the PLAN Submarine Academy have recognized the need to dedicate other PLAN vessels to SSBN support and cover, saying that while "the support and cover forces for nuclear attack submarines are mostly naval forces, the support and cover for strategic nuclear submarines requires, to the extent possible, the use of various military forces," presumably including forces from the PLA Air Force (PLAAF) and PLARF.[35] Other Chinese military analysts have recommended that the PLAN develop two "warship flotillas" to escort SSBNs from their homeports to the open ocean.[36] These flotillas, each consisting of four total destroyers and frigates, would be deployed early in a crisis and intended to escort SSBNs, with one flotilla assigned to the Okinawa trough and one to the western Pacific.[37] The need to protect the force may also have implications for future PLAN force development, as some independent Chinese analysts have argued for greater investment in both ASW capabilities and aircraft carriers to provide support and cover for SSBNs.[38] As Stefanick argues, China might also opt to operate its SSBNs near the Chinese coastline and protect them with shore-based assets.[39]

---

[33] Ibid., p. 6.

[34] If China were to deploy its SSBNs in bastions close to home, it might secure those bastions with its diesel-electric submarines rather than its nuclear-powered ones. China has relatively few nuclear-powered attack submarines, while diesel-electric submarines enjoy certain operational advantages over their nuclear-powered counterparts. Because they can run entirely on battery power and avoid moving parts, diesel-electric vessels can, for brief periods, operate much more quietly. An unclassified report from the Office of Naval Intelligence assesses that China's indigenous Song and Yuan diesel-electric attack submarines are significantly quieter than its SSBNs. The Kilo submarines purchased from Russia are the quietest in the entire PLA Navy. In addition, their generally smaller hull sizes afford diesel-electric submarines greater maneuverability, especially in littorals. For acoustic signature estimates, see "The People's Liberation Army Navy: A Modern Navy with Chinese Characteristics," p. 22.

[35] Liu, "Analysis of Requirements for Cover Support for Concealment of Nuclear Submarine," p. 363.

[36] 中国周边美国核潜艇围堵: 中国如何防范美国核潜艇? ["U.S. Nuclear Submarines Encircling China: How Can China Defend Against U.S. Nuclear Submarines?"], Hunan TV, 10 July 2015, http://v.cqnews.net/first/2015-07/10/content_34720181.htm, cited and discussed in Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, p. 59.

[37] Ibid. However, using other PLAN vessels, especially surface vessels, to protect the SSBN force might expose the location of the SSBNs, undermining one aspect of their survivability. Once it had developed SLBMs of sufficient range, the Soviet Union operated its SSBNs in protected bastions near its shores, though these were more easily defended than an SSBN in the open ocean. For some discussion, see Owen Cote, *The Third Battle: Innovation in the U.S. Navy's Silent Cold War Struggle with Soviet Submarines* (Newport, RI: Naval War College Press, 2003), pp. 64-65; and Jan S. Breemer, "The Soviet Navy's SSBN Bastions: Why Explanations Matter," *RUSI Journal*, vol. 134, no. 4 (1989), pp. 33-39.

[38] 张亦驰 [Zhang Yichi], 美日联手围堵中国潜艇 ["U.S. and Japan Work Together to Contain China's Submarines"], 中国国防报 [*China National Defense News*], 7 April 2015; and 中国在建世界最大核潜艇基地 整座大山都被挖空 ["China Building the World's Largest Nuclear Submarine Base—Entire Mountain Hollowed Out"], 西陆网 [*Xilu Network*], 23 November 2015, http://www.xilu.com/20151123/1000010000905341.html. For discussion, see Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, pp. 56-59.

[39] Stefanick, "Undersea Nuclear Forces: Survivability of Chinese, Russian, and U.S. SSBNs"; and personal correspondence.

Second, the PLA will need to develop personnel reliability and warhead handling programs for the SSBN force, which could lead to changes in its historically centralized approach to nuclear weapons.[40] China has traditionally maintained strict, centralized control over its nuclear warheads and adopted rigorous requirements for nuclear weapons personnel.[41] The need to provide warheads to the PLAN may require the establishment of new Navy-specific bodies and policies or the expansion of previously established ones.

It is unclear whether China has altered policies on either of these fronts, though available evidence suggests warhead handling may remain centralized. Curricular information from PLA professional military education (PME) institutes suggests that, so far, warhead handling may remain concentrated in the PLARF. Rocket Force Engineering University provides training and education in command and technical subjects for junior PLARF personnel. In its four-year bachelor's program, the University offers 16 different academic majors, including Nuclear Engineering and Technology, which specifically identifies among its competencies the handling of nuclear warheads. While many of the university's descriptions of the majors specify the role that they play in supporting the PLARF in particular, Nuclear Engineering and Technology is one of only two majors, along with Radiation Protection and Nuclear Safety, that describes cultivating talent for the entire PLA. According to a description of the Nuclear Engineering and Nuclear Technology major, it "aims to train junior command and technical officers engaged in nuclear warhead assembly testing, management and maintenance, combat application, manufacturing supervision, and application research for the *entire military*" [italics added].[42] The description similarly notes that "It is the only major in my country to train nuclear warhead technology and command military talents."[43] The Naval University of Engineering, by contrast, offers studies in Nuclear Engineering and Technology which makes a single reference to weapons safety, but is clearly focused on naval nuclear propulsion systems.[44]

The establishment and growth of a credible sea-based leg to China's nuclear forces provides new capabilities to the PLA but also imposes new demands on it. These demands may have implications for the PLAN's future force development, conventional naval operations, and internal bureaucratic politics.

Implications of the SSBN Force for China's Nuclear Strategy and Operations

The development of a credible SSBN force is likely to have important implications for China's nuclear strategy and operations. Here, I discuss how Chinese strategists view the sea-based leg of the triad and how the development of the SSBN force may create pressures for China to alter its nuclear strategy and operations.

---

[40] For a discussion of personnel reliability in the Rocket Force, see David C. Logan, "Rocket Force Personnel in the Age of Xi Jinping," in Roy Kamphausen, ed., *The People of the PLA 2.0* (Carlisle, PA: Army War College Press, 2021), pp. 74-84.

[41] Mark Stokes, "China's Nuclear Warhead Storage and Handling System," *Project 2049 Institute*, 12 March 2010, https://project2049.net/documents/chinas_nuclear_warhead_storage_and_handling_system.pdf.

[42] 核工程与核技术专业 ["Nuclear Engineering and Nuclear Technology Major"], 火箭军工程大学 [Rocket Force University of Engineering], https://web.archive.org/web/20181209093646mp_/http://www.epgc.net/zsxx/zszy/249355.shtml.

[43] Ibid.

[44] 核科学技术学院 ["School of Nuclear Science and Technology"], 海军工程大学 [Naval University of Engineering], http://www.nue.edu.cn/index.aspx?lanmuid=63&sublanmuid=701.

Historically, China's nuclear deterrent has depended on a land-based force of cave-rollout, silo-based and, recently, road-mobile ICBMs operated by the former Second Artillery (since 2016, the PLARF).[45] The development of the SSBN force, along with the reassignment of a nuclear mission to the Air Force, means that China's nuclear deterrent rests on multiple military services. As Roderick Lee points out, "A trend began to emerge by 2020 that suggested the PLARF was losing its relative share of the nuclear counterattack mission. Although the PLARF continues to maintain the lion's share of the PLA's total number of nuclear-capable launch systems, recent PLAN and PLAAF acquisitions of nuclear-capable systems are reducing the Rocket Force's relative standing."[46]

Chinese strategists have identified several advantages to the sea-based leg of a nuclear triad, including survivability, mobility, and prestige. According to PLA strategists with both the PLAN Submarine Academy and the Northern Theater Command Navy, "As an underwater launch platform for weapons, submarines have the characteristics of strong survivability, good concealment, high mobility, and flexible deployment. Deploying ballistic missiles on submarine platforms can increase the suddenness of attacks, enhance weapon penetration capabilities, and improve the success rate of combat missions."[47] PLAN strategists conclude that, given the efficacy of sea-based deterrents, "the ability of sea-based nuclear forces to exist at sea has become an important indicator for measuring the strategic nuclear strike capabilities and nuclear deterrence capabilities of nuclear-armed countries."[48]

Other experts have argued that SSBNs are especially useful at bolstering a country's status and prestige given the technological challenges of developing and operating the systems and the small number of countries that have successfully done so.[49] The 2013 edition of the *Science of Military Strategy* published by the PLA Academy of Military Science (AMS) argues that a sea-based nuclear deterrent "is seen by the world's main nuclear powers as a reliable means for maintaining a nuclear counterattack capability," noting that more than half of the deployed strategic nuclear warheads of nuclear powers France, Russia, the United Kingdom, and the United States are on SSBNs.[50] This

[45] For more on China's land-based nuclear and conventional missiles, see David C. Logan, "Making Sense of China's Missile Forces," in Phillip C. Saunders, Arthur S. Ding, Andrew Scobell, Andrew N.D. Yang, and Joel Wuthnow, eds., *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms* (Washington, D.C.: National Defense University Press, 2019), pp. 393-435.

[46] Roderick Lee, "PLA Rocket Force as a Service: New Team Player or Increasingly Irrelevant?" in Roger Cliff and Roy Kamphausen, eds., *Enabling a More Externally Focused and Operational PLA* (Carlisle, PA: Army War College Press, 2022), p. 137.

[47] 颜骥 [Yan Ji], 刘丙杰 [Liu Bingjie], and 王大伟 [Wang Dawei], 潜射弹道导弹作战目标选择研究 ["Research on Operational Targets Selection of Submarine-Launched Ballistic Missiles"], 舰船电子工程 [*Ship Electronic Engineering*], vol. 42, no. 8 (2022), p. 44. See also Hu, "Analysis of Sino-U.S. Asymmetric Nuclear Stability and U.S. Strategic Opportunism," p. 156.

[48] Li, Wang, and Xu, "Enlightenment of Foreign Submarine Alternation," p. 4.

[49] Hu, "Analysis of Sino-U.S. Asymmetric Nuclear Stability and U.S. Strategic Opportunism," pp. 61-85; 张耀 [Zhang Hui], 王永海 [Wang Yonghai], 王菁华 [Wang Jinghua], 李漫红 [Li Manhong], 王立研 [Wang Liyan], and 路瑞敏 [Lu Ruimin], 国外现役潜射弹道导弹技术性能综述与分析 ["Summary and Analysis of the Technical Performance of Submarine-Launched Ballistic Missiles in Active Service Abroad"]," 空天技术 [*Aerospace Technology*], no. 9 (2018), pp. 31-35; Tian, "Type 094 Nuclear Submarine—China's 'King of the South China Sea,'" pp. 60-61.

[50] 寿晓松 [Shou Xiaosong], ed., 战略学 [*The Science of Military Strategy*] (Beijing: Academy of Military Science, 2013), p. 214.

aspect of the sea-based leg may become more important in light of recent findings that Chinese leaders and media increasingly connect the country's nuclear forces to its status and prestige.[51]

In addition to the survivability and prestige benefits provided by sea-based deterrents, Chinese strategists highlight their ability to ensure penetration against ballistic missile defense (BMD) capabilities. Chinese experts have been concerned about the possibility that U.S. BMD systems, especially following a U.S. first strike against China's nuclear forces, could undermine Beijing's deterrent.[52] Recent nuclear exchange modeling by Chinese experts predicts that, after suffering a nuclear first strike from the United States, the chance of China successfully retaliating with only three nuclear warheads is 10 percent if Chinese nuclear forces are on peacetime alert and 56 percent if on full alert.[53] SSBNs provide several potential advantages for evading or penetrating U.S. BMD. The mobility of SSBNs allow them to launch from areas south of the United States on azimuths that evade U.S. homeland BMD systems, which are oriented toward the north and toward the west.[54] SLBMs can also be launched on depressed trajectories which can shorten the interception time, decrease their exposure to ground-based radars, and limit detection from space-based surveillance systems.[55]

Chinese analysts recognize these dynamics. One civilian expert with experience in the Chinese missile industry notes that, "If in the future China's nuclear submarines are quiet enough to freely break through the island chain and patrol any sea area, the U.S. anti-submarine system will not be able to give a general location indication, and the U.S. homeland missile defense system will directly face all submarine-launched missiles. Since Russia's strategic nuclear submarines have stopped patrolling in the southern hemisphere, the current US missile defense system is designed to target missiles coming from the north, and the missile early warning radar in the southern US has been dismantled. If China's nuclear submarine launches missiles in the South Pacific, it will put a lot of pressure on the U.S. anti-missile system."[56] The 2013 AMS *Science of Military Strategy* lauds the ability of SSBNs to negate BMD systems, saying that, "In view of the objective circumstances of active development of a missile defense system by the U.S. and some of [China's] surrounding nations, development of sea-based nuclear strength has important significance for maintaining the reliability, dependability, and effectiveness of our nuclear deterrence and nuclear counterattack."[57] This logic was reiterated in the 2020 edition of *Science of Military Strategy* published by the PLA

[51] David C. Logan and Phillip C. Saunders, "Discerning the Driver of China's Evolving Nuclear Forces: Explanatory Models, Observable Indicators, and New Data," working paper, March 2022.

[52] Fiona S. Cunningham and M. Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," *International Security*, vol. 40, no. 2 (2015), pp. 7-50; Tong Zhao, *Narrowing the U.S.-China Gap on Missile Defense: How to Help Forestall a Nuclear Arms Race* (Washington, D.C.: Carnegie Endowment for International Peace, 2020); and Logan, "Chinese Views of Strategic Stability."

[53] Wu Riqiang, "Living with Uncertainty: Modeling China's Nuclear Survivability," *International Security*, vol. 44, no. 4 (2020), p. 112.

[54] Wu Riqiang, "Survivability of China's Sea-Based Nuclear Forces," *Science & Global Security*, vol. 19, no. 2 (2011), pp. 91-120.

[55] Lisbeth Gronlund and David C. Wright, "Depressed Trajectory SLBMs: A Technical Evaluation and Arms Control Possibilities," *Science & Global Security*, vol. 3, no. 1-2 (1992), p. 131.

[56] Wu, "How the U.S. and China Can Avoid a Nuclear Arms Race," pp. 39-60, 122-123.

[57] Shou, ed., *The Science of Military Strategy*, p. 214.

National Defense University, which states that, "Especially with the development of anti-missile weapon systems, the advantages of sea-based nuclear power have become more prominent."[58]

The development of a credible sea-based deterrent may create pressures for China to alter its nuclear strategy and operations in several ways. First, the realization of a full nuclear triad may lead the PLA to construct bodies and processes for maintaining real-time awareness of the status of China's nuclear deterrent, and for targeting coordination and deconfliction among the nuclear capabilities of the Rocket Force, the Navy, and the Air Force. These mechanisms could provide the PLA a greater say in setting nuclear strategy, a field from which it has historically been marginalized. Although China's nuclear triad is only now developing, previous PLA writings have hinted at this kind of nuclear integration across the services. For example, the *Science of Second Artillery Campaigns*, an internal document outlining the operations of China's land-based missile forces, notes that although the land-based nuclear forces are the key forces for nuclear counterattack, the nuclear forces of the PLAN and PLAAF would also play a role in "joint nuclear counterattack operations."[59] Similarly, language in the 2015 edition of *Science of Military Strategy* published by the PLA National Defense University (NDU) suggests that the SSBN force might complement nuclear counterattacks carried out by the PLARF, and the 2020 edition of the PLA NDU *Science of Military Strategy* notes that "At present, ballistic missile nuclear submarines, strategic bombers and land-based intercontinental ballistic missiles together constitute a 'triad' strategic deterrent force."[60] More recently, researchers at the PLAN Submarine Academy and the Northern Theater Command Navy have investigated the relative strengths and weakness of different legs of the nuclear triad in striking different target sets. Using nuclear exchange simulations, the researchers conclude that, given the relatively high circular error probable (CEP) of China's SLBMs, "hard-point and mobile strategic targets should not be the primary combat targets of submarine-launched ballistic missiles."[61]

Second, the creation and expansion of a credible sea-based deterrent means the establishment and empowerment of additional nuclear constituencies within the PLA, which might advocate for a greater role for nuclear weapons in China's national security strategy. The Rocket Force, Navy, and Air Force may logroll efforts to expand China's nuclear weapons in order to secure greater resources and prestige. Nuclear constituencies in the PLA might also push for loosening the restrictions on China's nuclear practices in order to obtain greater influence and autonomy.[62]

Third, the operational requirements of an SSBN force may encourage China to reconsider some of its longstanding nuclear weapons practices. Historically, China's nuclear practices have prioritized political control over operational responsiveness. This prioritization was reflected in the PLA's decision to store delivery vehicles and launchers separately and Rocket Force units training to launch

---

[58] Xiao, ed., *Science of Military Strategy*, 2020, p. 156.

[59] 于际训 [Yu Jixun], ed., 第二炮兵战役学 [*The Science of Second Artillery Campaigns*] (Beijing: People's Liberation Army Press, 2004), p. 297.

[60] 肖天亮 [Xiao Tianliang], ed., 战略学 [*Science of Military Strategy*] (Beijing: National Defense University Press, 2015), p. 235; and Xiao, ed., *Science of Military Strategy*, 2020, p. 156.

[61] Yan, Liu, and Wang, "Research on Operational Targets Selection of Submarine-Launched Ballistic Missiles," p. 44.

[62] The political science literature has identified a general preference of military organizations for offensive doctrines characterized by high responsiveness. There is some evidence that the PLA has favored a more "assertive" nuclear posture including qualifications to China's no-first-use policy and higher levels of alert. For literature on the "cult of the offensive," see Jack Snyder, "Civil-Military Relations and the Cult of the Offensive, 1914 and 1984," *International Security*, vol. 9, no. 1 (Summer 1984), pp. 108-146; Barry R. Posen, *The Sources of Military Doctrine*, (Cornell, N.Y.: Cornell University Press, 1984); and Stephen Van Evera, "The Cult of the Offensive and the Origins of the First World War," *International Security*, vol. 9, no. 1 (Summer 1984), pp. 58-107.

missiles days or sometimes weeks after China suffered a nuclear strike.[63] However, SSBNs must be deployed with warheads mated to their missiles, while the need to remain undetected complicates efforts to communicate with deployed SSBNs.[64] This may increase pressure on China to loosen the restrictions it has historically placed on its nuclear weapons. Researchers at the PLAN Submarine Academy have recognized some of these challenges, writing that "relevant command departments must draw up war plans and contingency plans in advance and consider ahead of time all manner of complex situations in order to ensure the smooth completion of the missile attack mission."[65]

Implications of the SSBN Force for Strategic Stability

The growth and improvement of the PLAN's SSBN force will also have important, and potentially competing, implications for strategic stability between China and the United States. Here, I address three ways in which the SSBN force may impact strategic stability between China and the United States: by enhancing the survivability of China's nuclear deterrent and decreasing use-or-lose pressures on Chinese decisionmakers, by encouraging Chinese aggression at the conventional level, and by potentially creating new inadvertent escalation pressures stemming from conventional-nuclear entanglement.

First, the development of a credible sea-based deterrent, to the extent it strengthens Chinese decisionmakers' confidence in the survivability of the country's nuclear deterrent, may have multiple effects on use-or-lose pressures and crisis stability. On the one hand, it may decrease some forms of escalation pressures by making Chinese decisionmakers more confident in the country's survivable second strike. Chinese experts frequently raise concerns that advancements in U.S. nuclear, ballistic missile defense, and conventional precision strike capabilities could undermine China's nuclear deterrent.[66] In a crisis or conflict, these concerns could present Chinese decisionmakers with use-or-lose pressures which could encourage nuclear use.[67] The addition of the SSBN force, however, to the extent that it strengthens the survivability of China's nuclear deterrent, should decrease these

---

[63] Fiona S. Cunningham and M. Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," *International Security*, vol. 40, no. 2 (Fall 2015), pp. 13-15. For more on the former Second Artillery's base organization, see Mark Stokes, "China's Nuclear Warhead Storage and Handling System," Project 2049 Institute, 12 March 2010, https://project2049.net/documents/chinas_nuclear_warhead_storage_and_handling_system.pdf. For evidence of the readiness level of China's land-based nuclear forces, see 刘王虎 [Liu Wanghu], 二炮士兵隐蔽在地下洞库 8 天生吃韭菜甜椒 ["Second Artillery Soldiers Hidden in Underground Caverns for 8-Day Exercise Eat Leeks and Sweet Peppers"], 解放军报 [*PLA Daily*], 6 May 2013, http://mil.news.sina.com.cn/2013-05-06/0420723740.html; 二炮部队 58 名女兵进 驻大山隐蔽洞库发射导弹 ["58 Female Soldiers of the Second Artillery Stationed in Dashan Concealed Cavern to Launch Missiles"], 新浪军事 [*Sinica Military*], 17 May 2013, http://mil.news.sina.com.cn/2013-05-17/1509724974.html; and 杨承军 [Yang Chengjun], 核战略专家杨承军：不宜在网络上炒作涉核问题 ["Nuclear Strategy Expert Yang Chengjun: It Is Not Appropriate to Hype Nuclear-Related Issues on the Internet"], 祖国 [*Motherland*], 13 May 2020.

[64] For more discussion, see David C. Logan, "China's Future SSBN Command and Control Structure," INSS Strategic Forum, National Defense University, November 2016, https://ndupress.ndu.edu/Media/News/Article/1013472/chinas-future-ssbn-command-and-control-structure/.

[65] 杨洪波 [Yang Hongbo], 李建林 [Li Jianlin], and 洪贞启 [Hong Zhenqi], 潜射导弹作战指挥辅助决策支持系统框架 ["Framework for an Auxiliary Decision-Making Support System for SLBM War Command"], 火力与指挥控制 [*Fire Control and Command Control*], vol. 40, no. 1 (January 2015), p. 123.

[66] Cunningham and Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and U.S.-China Strategic Stability," pp. 7-50; and Logan, "Chinese Views of Strategic Stability."

[67] David C. Logan, "Between a Rock and a Hard Place: Unpacking the Use-It-Or-Lose-It Dilemma," working paper, March 2023.

pressures. On the other hand, the concentration of a large number of nuclear warheads on a few noisy vessels could introduce new forms of use-or-lose pressures. As one Chinese strategist has argued, "The attacked party will face the choice of either allowing the opponent to destroy its own sea-based nuclear power and weakening its nuclear deterrence capability, or launching the sea-based nuclear missile before the strategic missile nuclear submarine is destroyed. The 'use it or lose it' choice would force the party being struck to prefer nuclear weapons first, which would reduce crisis stability."[68]

Second, China might use its stronger nuclear forces as a shield behind which to initiate conventional aggression.[69] China would likely be less susceptible to U.S. nuclear threats and intimidation.[70] If China's nuclear inferiority vis-à-vis the United States restrained Chinese aggression, then a larger and more survivable nuclear arsenal may reduce the perceived escalation risks of a conflict.[71] In fact, some Chinese strategists have argued that a strong sea-based nuclear deterrent, in particular, might help dissuade U.S. military intervention in the region, writing that "my country can also deter direct military intervention by foreign powers in the East China Sea and South China Sea through effective underwater nuclear deterrence capabilities."[72]

Third, China's growing SSBN force may also have implications for inadvertent escalation stemming from conventional-nuclear "entanglement." Analysts have recently discussed the escalation risks that stem from the entanglement of conventional and nuclear systems. Previous work has described entanglement as "a range of circumstances in which the operations of nuclear forces may overlap with those of conventional forces. Entanglement may occur when both conventional and nuclear systems are located in the same geographic area, when they are controlled by the same institutions and systems, when they are subject to similar employment practices, or when they rely on similar delivery systems."[73] Entanglement can occur geographically, when conventional and nuclear systems are garrisoned or operate in the same areas, operationally, when they are subject to the same command and control structures or operating practices, and technologically, when they exhibit similar detection signatures.[74] Entanglement can increase escalation risks by raising the likelihood that entangled nuclear forces or their supporting elements are inadvertently targeted in a conventional

[68] Hu, "Analysis of Sino-U.S. Asymmetric Nuclear Stability and U.S. Strategic Opportunism," p. 78.

[69] For a review of similar arguments, see David C. Logan and Phillip C. Saunders, "Discerning the Drivers of China's Evolving Nuclear Forces: Explanatory Models, Observable Indicators, and New Data," China Strategic Perspectives 18 (Washington, DC: NDU Press, forthcoming); and Caitlin Talmadge, "China and Nuclear Weapons," Brookings Institution, September 2019, 7, https://www.brookings.edu/wp-content/uploads/2019/09/FP_20190930_china_nuclear_weapons_talmadge-1.pdf.

[70] Phillip C. Saunders and David C. Logan, "The Implications of the PLA's Nuclear Expansion and Modernization for China's Crisis Behavior," Paper prepared for the PLA Actions and Behavior in a Crisis conference, co-hosted by the National Bureau of Asian Research and U.S. Indo-Pacific Command, 17 July 2022, pp. 8-10.

[71] Scholars have shown how, in other cases, the mutual possession of nuclear weapons can increase the likelihood of lower-level conflicts, including conventional conflicts and proxy conflicts. See, for example, Bryan R. Early and Victor Asal, "Nuclear Weapons, Existential Threats, and the Stability-Instability Paradox," *The Nonproliferation Review*, vol. 25, no. 3-4 (2018), pp. 223-247; Kyle Atwell and David C. Logan, "Shadow Conflicts in the Shadow of the Bomb: The Link Between Nuclear Weapons and Indirect Conflict," working paper; and Dominic Tierney, "The Future of Sino-U.S. Proxy War," *Texas National Security Review*, vol. 4, no. 2 (Spring 2021), pp. 50-73.

[72] Ling, "2018 South China Sea Military Parade," p. 19.

[73] David C. Logan, "Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-Conventional Entanglement in China," *Journal of Strategic Studies*, vol. 46, no. 1 (2023), p. 6.

[74] Ibid., pp. 13-16.

crisis or conflict. Entanglement can also create ambiguity about the armament of incoming strikes from potentially entangled or ambiguous systems.[75]

While, in the China context, most of this work has focused on land-based platforms, the same risks may exist at sea.[76] China's submarine force is expanding, creating the possibility for conventional-nuclear entanglement at sea. Alongside its six SSBNs, the PLAN also operates six nuclear-powered attacks submarines (SSN) and 44 diesel-powered/air-independent powered attack submarines (SS/SSP).[77] In addition, the 2022 report on the PLA from the Office of the Secretary of Defense assesses that "By the mid-2020s, China will likely build the SHANG class (Type 093B) guided-missile nuclear-powered attack submarine (SSGN)."[78]

Geographically, China's SSBNs may operate near some of its nuclear-powered attack submarines, whether deployed in bastions or being escorted to the open ocean. China's SSBNs and SSNs frequently visit the same ports.[79] Operationally, the most significant potential source of entanglement for the SSBN force is the possibility of overlapping command and control. According to one Chinese expert, "China's communication systems for submarines are used for both SSNs and SSBNs, and those large, land-based communication stations are vulnerable to conventional attacks."[80] Technologically, SSBNs and SSNs might exhibit similar acoustic signatures, though this remains unclear. China's SSBN designs are reportedly based on earlier generation SSNs.[81] Some Chinese analysts have suggested that SSBNs be equipped with conventionally armed JL-2 SLBMs in order to maximize the use of the expensive platforms.[82] More research is needed to assess the escalation risks of entanglement at sea, but China's operational and technological choices will have significant influence on those risks.

Conclusion

China's development of a credible sea-based deterrent has important implications for the PLAN, for China's nuclear strategy, and for U.S.-China strategic stability. For the PLAN, the need to protect the SSBN force may divert resources away from other missions; it may also provide justification for further expansion of the PLAN fleet size.[83] For China's nuclear strategy and operations, the SSBN force may increase operational and bureaucratic pressures for adopting a more forward-leaning nuclear strategy. For U.S.-China strategic stability, the SSBN force will have complex effects,

---

[75] For more conceptual discussion, see Ibid.

[76] See, for example, Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War with the United States," *International Security*, vol. 41, no. 4 (2017), pp. 50-92; Wu Riqiang, "Assessing China-U.S. Inadvertent Nuclear Escalation," *International Security*, vol. 46, no. 3 (2021/2022), pp. 128-162; and Logan, "Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-Conventional Entanglement in China," pp. 5-55. For an earlier assessment of conventional-nuclear entanglement risks in the PLAN, see Christopher Lay, "Assessing Chinese Nuclear Entanglement and Escalatory Risk via SSBNs in the South China Sea," *Georgetown Security Studies Review*, vol. 9, no. 2 (April 2022), pp. 32-37.

[77] *Annual Report to Congress: The Military Power of the People's Republic of China 2022*, p. 52.

[78] Ibid., p. 53.

[79] Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, p. 42

[80] Wu, "Assessing China-U.S. Inadvertent Nuclear Escalation," p. 149.

[81] Ibid., p. 142.

[82] 疑似中国海军最新 094A 战略核潜艇首次曝光 ["Suspected Newest 094A Strategic Nuclear Submarine of the Chinese Navy Was Revealed"], 新浪军事 [*Sina Military*], 5 July 2016, http://mil.news.sina.com.cn/china/2016-07-05/doc-ifxtsatn8121274.shtml.

[83] Zhao, *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability*, pp. 56-59.

decreasing risks that Chinese decisionmakers confront use-or-lose escalation pressures, making China less susceptible to U.S. nuclear threats and intimidation and therefore perceiving lower costs to conventional aggression, and potentially introducing escalation risks from conventional-nuclear entanglement to the maritime domain.

The findings reported here have important implications for both U.S. policy and for future research on the PLA. First, the U.S. Navy and intelligence community should identify and assess the escalation risks stemming from conventional-nuclear entanglement at sea. U.S. decisionmakers and operational plans must account for these risks. Addressing the risks may require tradeoffs between maximizing conventional advantages and limiting the risks of nuclear use by, for instance, limiting ASW against Chinese SSBNs and supporting capabilities. Second, possible nuclear arms control agreements between China and the United States must account for other legs of the Chinese deterrent. While the current poor state of U.S.-China relations makes near-term arms control unlikely, decision makers can lay the foundation now for future agreements.[84] Proposals for U.S.-China arms control have largely focused on China's land-based missiles.[85] However, potential arms control efforts will need to consider how to incorporate the specific challenges of other legs of a Chinese nuclear triad. Third, the U.S. Navy will have to weigh the costs, benefits, and risks of allocating military assets to either the strategic ASW mission targeting Chinese SSBNs or to conventional military operations.[86] In a crisis or conflict, tracking or targeting Chinese SSBNs might provide the United States coercive leverage or help support a damage limitation nuclear strategy, but it would reduce the resources available for other missions and might be viewed as an escalatory attempt to undermine China's strategic deterrent. Finally, China analysts may need to increasingly consider domestic, non-strategic drivers of the country's nuclear strategy and operations. While China's nuclear strategy likely remains sensitive to U.S. policy choices, factors rooted in bureaucratic posturing, domestic politics, and international prestige may become increasingly important for Beijing. It may be more challenging for the United States to influence these factors.

[84] David C. Logan, "Trilateral Arms Control: A Realistic Assessment of Chinese Participation," Stimson Center, 9 August 2021, https://www.stimson.org/2021/trilateral-arms-control-a-realistic-assessment-of-chinese-participation/.

[85] Tong Zhao, "Practical Ways to Promote U.S.-China Arms Control Cooperation," Carnegie Endowment for International Peace, 2020, https://carnegieendowment.org/files/Outlook_Zhao_ArmsControl-Updated.pdf.

[86] I thank Tom Stefanick for this point.

About the Author

Dr. David C. Logan is Assistant Professor of Security Studies at the Fletcher School of Law and Diplomacy at Tufts University. His research focuses on nuclear weapons, arms control, deterrence, and the U.S.-China security relationship. He previously taught in the National Security Affairs Department at the Naval War College and served as a Stanton Nuclear Security Fellow with the MIT Security Studies Program and a Fellow with the Princeton Center for International Security Studies, where he was also Director of the Strategic Education Initiative. Dr. Logan has conducted research for the Center for the Study of Chinese Military Affairs at National Defense University, the Defense Threat Reduction Agency, and the Office of Net Assessment. He has published in *International Security*, *Journal of Strategic Studies*, Georgetown University Press, National Defense University Press, *Foreign Affairs*, *Los Angeles Times*, and *War on the Rocks*, among other venues. He holds a B.A. from Grinnell College and an M.P.A., M.A., and Ph.D. from Princeton University.

The author wishes to thank Tom Stefanick, Liza Tobin, CDR Robert C. Watts IV, and the members of the China Maritime Studies Institute for helpful comments on earlier versions of this report.