

U.S.-China Economic and Security Review Commission

Staff Research Report



October 28, 2015

China's New YJ-18 Antiship Cruise Missile: Capabilities and Implications for U.S. Forces in the Western Pacific

Author: Michael Pilger, Research Fellow, Security and Foreign Affairs

Acknowledgments: James Acton, Christopher Carlson, Jeffrey Engstrom, Robert Haddick, Christopher Twomey, and Christopher Yeaw provided helpful insights and reviewed drafts of this paper, but do not necessarily agree with or endorse the assessments and statements contained herein. Errors and views are the author's own.

Disclaimer: This paper is the product of professional research performed by staff of the U.S.-China Economic and Security Review Commission, and was prepared at the request of the Commission to support its deliberations. Posting of the report to the Commission's website is intended to promote greater public understanding of the issues addressed by the Commission in its ongoing assessment of U.S.-China economic relations and their implications for U.S. security, as mandated by Public Law 106-398 and Public Law 108-7. However, the public release of this document does not necessarily imply an endorsement by the Commission, any individual Commissioner, or the Commission's other professional staff, of the views or conclusions expressed in this staff research report.

Introduction

In April 2015, the U.S. Office of Naval Intelligence confirmed that China has deployed the YJ-18 antiship cruise missile (ASCM) on some People's Liberation Army (PLA) Navy submarines and surface ships.¹ The YJ-18's greater range and speed than previous Chinese ASCMs, along with its wide deployment across PLA platforms, would significantly increase China's antiaccess/area denial capabilities* against U.S. Navy surface ships operating in the Western Pacific during a potential conflict. The YJ-18 probably will be widely deployed on China's indigenously built ASCM-capable submarines and newest surface ships by 2020, and China could develop a variant of the YJ-18 to replace older missiles in its shore-based ASCM arsenal. This paper assesses the capabilities of the YJ-18 and describes the implications of its wide deployment for U.S. forces operating in the Western Pacific. The author exclusively used open source information and considered the capabilities of similar missiles to assess the likely characteristics of the YJ-18.[†]

Characteristics of the YJ-18

- **Speed:** The YJ-18 has a subsonic cruise speed, reportedly about 600 miles per hour (mph), or Mach 0.8.² Media reports suggest that when the missile is about 20 nautical miles (nm) from its target, the warhead accelerates to supersonic speed, reportedly up to Mach 3.0.³ The more fuel-efficient subsonic stage of the YJ-18's flight increases its overall range, and the supersonic terminal flight stage reduces the time adversary forces have to engage the missile.⁴
- **Range:** According to the U.S. Department of Defense, the YJ-18 has a range of 290 nm.^{5,‡} The YJ-18's predecessor on many Chinese submarines, the YJ-82, has a range of about 20 nm.⁶
- **Flight path:** The YJ-18 most likely follows a sea-skimming flight path as it approaches its target.⁷ By flying only a few meters above the sea, the missile attempts to evade detection by surface radar until it breaks the radar horizon 16 to 18 nm from its target.⁸
- **Payload:** Authoritative open source information on the YJ-18's physical dimensions, including the size of its conventional warhead, is scarce. Some sources, including an *IHS Jane's* report, suggest the YJ-18's warhead weighs 300 kilograms (kg),⁹ though other sources suggest it weighs only 140 kg.¹⁰
- **Targeting:** China is focused on building a robust C4ISR[§] system for detecting ships and aircraft over the horizon, which would provide targeting data to antiship missiles such as the YJ-18.¹¹ This system

* According to the U.S. Department of Defense, "antiaccess" actions are intended to slow deployment of an adversary's forces into a theater or cause them to operate at distances farther from the conflict than they would prefer. "Area denial" actions affect maneuvers within a theater, and are intended to impede an adversary's operations within areas where friendly forces cannot or will not prevent access. China, however, uses the term "counterintervention," reflecting its perception that such operations are reactive. U.S. Department of Defense, *Military and Security Developments Involving the People's Republic of China 2013*, 2013, i, 32, 33; U.S. Department of Defense, *Air Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges*, May 2013, 2.

† The YJ-18 is widely reported to be a variant of the Russian SS-N-27 Klub ASCM, but the extent of the similarities between the two missiles is unknown. Lyle J. Goldstein, "China's YJ-18 Supersonic Anti-Ship Cruise Missile: America's Nightmare?" *National Interest*, June 1, 2015. <http://nationalinterest.org/feature/chinas-yj-18-supersonic-anti-ship-cruise-missile-americas-13010?page=show>; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2015*, May 2015, 46; *Sputnik News*, "China's YJ-18 Missiles a 'Major Threat' to US Navy," April 15, 2015. <http://sputniknews.com/asia/20150415/1020902506.html>; and *Want China Times*, "PLA's YJ-18 Anti-Ship Missile Useful against US Carrier Group," December 3, 2014. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20141203000057&cid=1101>.

‡ Sources disagree on the assessed range of the YJ-18. The U.S. Office of Naval Intelligence has not publicly reported the estimated range of the missile, but has said the YJ-18 "extends a similar capability" to China's ASCM submarines as does the SS-N-27 ASCM, which has a range of 120 nm. Christopher Carlson, a former Defense Intelligence Agency intelligence officer, estimates the YJ-18's range is similar to that of the SS-N-27. Reporting by *IHS Jane's* also supports an estimate of the YJ-18's range of about 120 nm. Christopher Carlson, former Defense Intelligence Agency intelligence officer, interview with Commission staff, October 1, 2015; *IHS Jane's*, "Jane's Strategic Weapon Systems: Yong Ji-18 (YJ-18)," June 5, 2015; and U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 19.

§ C4ISR stands for command, control, communications, computers, intelligence, surveillance, and reconnaissance.

incorporates an array of ship-borne and land-based radar (including over-the-horizon radar); a constellation of imaging satellites; and a variety of intelligence, surveillance, and reconnaissance aircraft.¹² However, China's C4ISR infrastructure might be insufficient to generate and fuse the targeting information necessary to take advantage of the YJ-18's assessed range.¹³ According to the Department of Defense, "It is ... unclear whether China has the capability to collect accurate targeting information and pass it to launch platforms in time for successful [antiship missile] strikes in sea areas beyond the first island chain."^{14*} Moreover, some systems in China's C4ISR infrastructure may be vulnerable to countermeasures, such as electromagnetic warfare operations, that could degrade the ability of the PLA to detect, identify, and track enemy ships and employ antiship missiles against them in a contingency.¹⁵

- *Navigation:* The YJ-18 most likely is capable of using waypoint navigation and onboard radar-seeking technology to navigate to its target.¹⁶

Deployment of the YJ-18

China's SHANG II-class nuclear attack submarines are widely reported to have been outfitted with vertical missile launchers, which may indicate these submarines already carry the YJ-18.¹⁷ Ultimately, China will deploy the YJ-18 on its YUAN-class air-independent diesel attack submarines (currently numbering 12), SONG-class diesel attack submarines (currently numbering 13), and SHANG I- and SHANG II-class nuclear attack submarines (currently numbering two each).¹⁸ Previously, all of these submarines—possibly excluding the SHANG II-class—carried the subsonic YJ-82.¹⁹ China most likely will also deploy the YJ-18 on its Type 095 nuclear attack submarine, which is still under development.²⁰ China's ASCM-capable submarine fleet also includes eight Russian-built KILO-class diesel attack submarines carrying the Russian SS-N-27 ASCM, which has supersonic sprint capabilities similar to the YJ-18 and a range of 120 nm.²¹ China also operates three aging HAN-class nuclear submarines capable of firing the YJ-82, but these boats are unlikely to be upgraded to carry the YJ-18.²²

The YJ-18's wide deployment would reduce missile production costs, streamline missile maintenance, and increase the range and firepower of many platforms and missile units. China could deploy YJ-18 variants to replace diverse ASCMs across the PLA. China already has deployed a surface-launched YJ-18 variant on some of its LUYANG III-class guided missile destroyers (DDGs), and may deploy the YJ-18 on its future Type 055 DDG.²³ The YJ-18 improves the range and lethality of the LUYANG III, which was already equipped with advanced missile and missile defense capabilities, including what some Chinese media call the "Chinese Aegis."²⁴ In addition, China could develop a ground-launched variant of the YJ-18 to replace the subsonic YJ-62 ASCM (range of 150 nm) in shore-based missile units.

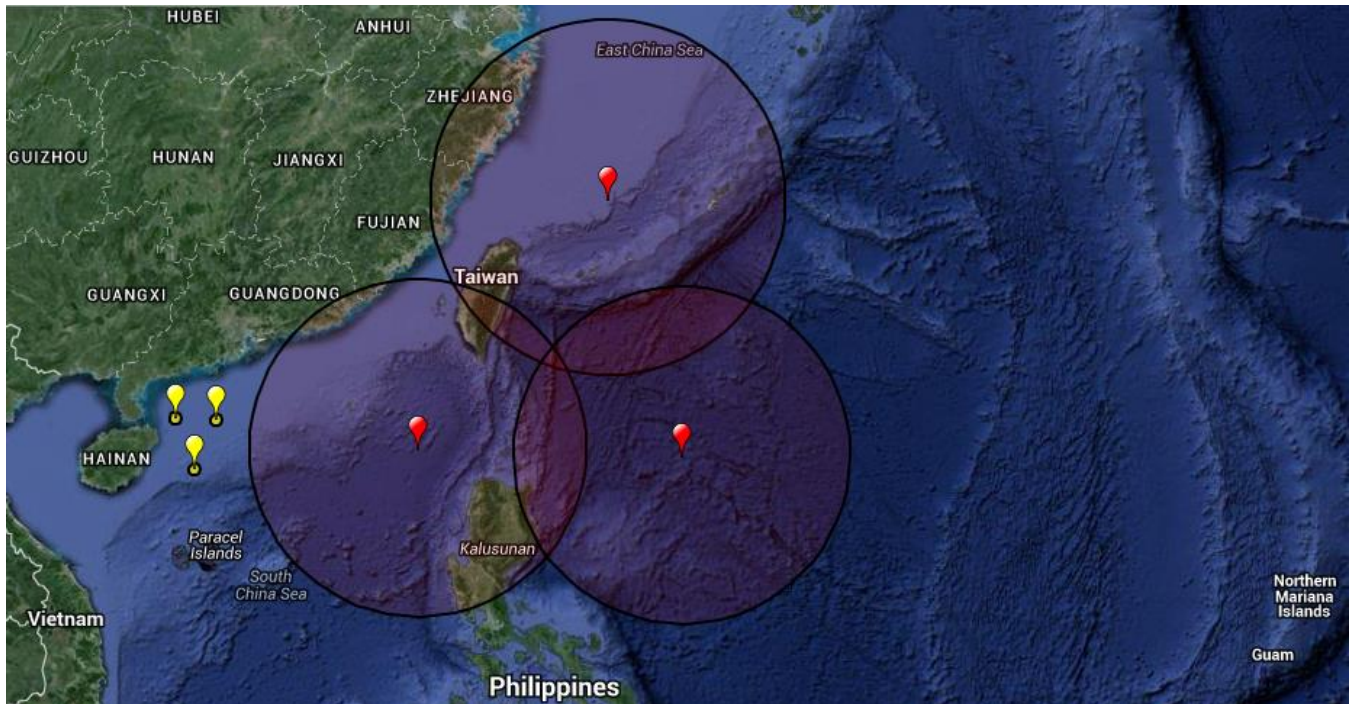
Implications for U.S. Military Operations in the Western Pacific

The YJ-18's supersonic speed and long range, as well as its wide deployment on PLA Navy platforms, could have serious implications for the ability of U.S. Navy surface ships to operate freely in the Western Pacific in a contingency.

- The YJ-18's assessed 290 nm range creates a threat ring covering approximately 264,200 square nautical miles (sq nm), compared to the YJ-82's threat ring of about 1,250 sq nm. These larger threat rings will greatly expand the area U.S. forces must monitor for PLA Navy submarine activity (see Figure 1). Although many submarines that will carry the YJ-18 are relatively noisy, the process of detecting and engaging these submarines will complicate the task of defending U.S. Navy surface ships from cruise missile attacks.²⁵

* The first island chain refers to a line of islands running through the Kurile Islands, Japan and the Ryukyu Islands, Taiwan, the Philippines, Borneo, and Natuna Besar. The second island chain is farther east, running through the Kurile Islands, Japan, the Bonin Islands, the Mariana Islands, and the Caroline Islands. PLA strategists and academics have long asserted the United States relies primarily on the first island chain and the second island chain to strategically "encircle" or "contain" China and prevent the PLA Navy from operating freely in the Western Pacific. Open Source Center, "PRC Article Surveys China's Naval Rivals, Challenges," January 6, 2012. ID: CPP20120109671003; Bernard D. Cole, *The Great Wall at Sea* (Second Edition), Naval Institute Press, 2010, 174–176.

Figure 1: Potential Overlapping Threat Rings of Three YJ-18-Equipped Submarines (Red Markers) and Potential Threat Rings of Three YJ-82-Equipped Submarines (Yellow Markers)



Note: The locations of the submarines in this image are hypothetical, and the ranges depicted are approximate. Three YJ-82-equipped submarines are depicted near the Chinese mainland for clarity, rather than to suggest these submarines would necessarily operate in these waters in a contingency. In a Taiwan contingency, PLA Navy ASCM-equipped submarines likely would attempt to challenge points of ingress for U.S. Navy surface ships entering the theater. The threat rings of the YJ-18-equipped submarines reflect the maximum assessed range of the YJ-18. In a contingency, technical limitations, such as a lack of accurate targeting data, could significantly shorten the effective range of the YJ-18.

Source: GmapGIS; Google Earth.

- The YJ-18’s wide deployment and long range would increase China’s ability to launch standoff* multi-axis, multi-missile attacks against U.S. Navy surface ships. Such attacks are formidable challenges for shipboard defenses, and the YJ-18’s supersonic sprint capabilities will further increase the likelihood some missiles would penetrate a U.S. ship’s missile defenses.²⁶ The YJ-18 is one of a variety of anti-ship missiles that provide China a multilayered antiaccess/area denial capability in its near seas† and beyond (see Figure 2). In a 2014 volume on China’s cruise missiles, China military experts Dennis Gormley, Andrew Erickson, and Jingdong Yuan assessed, “It appears that China’s increasing ASCM inventory has increasing potential to saturate U.S. Navy defenses.”²⁷

* Standoff capability refers to a platform’s ability to fire from a range that increases its chance of surviving an exchange of fire.

† China typically defines its “near seas” as waters within the Yellow Sea, East China Sea, and South China Sea.

Figure 2: Selected Chinese Antiship Missiles²⁸

| Designator and Missile Type | Platform | Top Speed | Approximate Range (nm) |
|-----------------------------|---------------------------------|------------|------------------------|
| YJ-83 ASCM | Air and surface variants | Subsonic | 100+ |
| YJ-82 ASCM | Subsurface | Subsonic | 20 |
| YJ-81 ASCM | Air | Subsonic | 27 |
| YJ-8A ASCM | Surface | Subsonic | 23 |
| YJ-62 ASCM | Ground and surface variants | Subsonic | 150 |
| YJ-18 ASCM | Subsurface and surface variants | Supersonic | 290 |
| YJ-12 ASCM | Air | Supersonic | 216 |
| SS-N-27 ASCM | Subsurface | Supersonic | 120 |
| SS-N-22 ASCM | Surface | Supersonic | 65 |
| DF-21D ASBM | Ground | Supersonic | 810+ |
| DF-26 ASBM | Ground | Supersonic | 1,620+ |

Note: The DF-21D and DF-26 are antiship ballistic missiles (ASBMs).*

- The U.S. Navy is exploring advanced ship defense technologies—such as electromagnetic railguns and directed energy weapons—that could mitigate the vulnerability of U.S. Navy surface ships to long-range, supersonic missile strikes.²⁹ The U.S. Navy currently lacks a supersonic ASCM, but has acquired sea-skimming supersonic target vehicles to simulate attacks by supersonic ASCMs and to develop defenses against similar missiles.³⁰
- China’s long-distance submarine deployments in recent years, including deployments of SHANG- and YUAN-class submarines to the Indian Ocean, suggest Chinese submarines carrying the YJ-18 could impede the progress of a carrier strike group in the Western Pacific and in the Indian Ocean, and could hold at risk a carrier strike group in the Western Pacific.³¹

* During China’s September 2015 military parade marking the 70th anniversary of the end of World War II, China debuted the DF-26 intermediate-range ballistic missile, which the parade announcer described as having antiship capabilities. This announcement appears to confirm western media speculation about the antiship capabilities of the DF-26. However, authoritative information from U.S. government sources on the DF-26’s capabilities is not publicly available. Andrew S. Erickson, “Showtime: China Reveals Two ‘Carrier-Killer’ Missiles,” *National Interest*, September 3, 2015. <http://nationalinterest.org/feature/showtime-china-reveals-two-carrier-killer-missiles-13769>; Wendell Minnick, “China’s Parade Puts US Navy on Notice,” *Defense News*, September 3, 2015. <http://www.defensenews.com/story/defense/naval/2015/09/03/chinas-parade-puts-us-navy-notice/71632918/>; Richard D. Fisher Jr., “China Previews New Ballistic Missiles in Practices for September 3 Parade,” *IHS Jane’s Defense Weekly*, August 30, 2015. <http://www.janes.com/article/53896/china-previews-new-ballistic-missiles-in-practices-for-3-september-parade>; and Bill Gertz, “China Fields New Intermediate-Range Ballistic Missile,” *Washington Free Beacon*, March 3, 2014. <http://freebeacon.com/national-security/china-fields-new-intermediate-range-nuclear-missile/>.

Endnotes

- ¹ U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16, 19.
- ² Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Potent Vector: Assessing Chinese Cruise Missile Developments,” *National Defense University Press*, September 30, 2014. <http://ndupress.ndu.edu/Media/News/NewsArticleView/tabid/7849/Article/577568/jfq-75-a-potent-vector-assessing-chinese-cruise-missile-developments.aspx>.
- ³ *IHS Jane’s*, “Jane’s Strategic Weapon Systems: Yong Ji-18 (YJ-18),” June 5, 2015; Lyle J. Goldstein, “China’s YJ-18 Supersonic Anti-Ship Cruise Missile: America’s Nightmare?” *National Interest*, June 1, 2015. <http://nationalinterest.org/feature/chinas-yj-18-supersonic-anti-ship-cruise-missile-americas-13010?page=show>; *Want China Times*, “New Vertical-Launch Missile in CCTV Report May Be YJ-18,” November 27, 2014. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20141127000117&cid=1101>; and Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Potent Vector: Assessing Chinese Cruise Missile Developments,” *National Defense University Press*, September 30, 2014. <http://ndupress.ndu.edu/Media/News/NewsArticleView/tabid/7849/Article/577568/jfq-75-a-potent-vector-assessing-chinese-cruise-missile-developments.aspx>.
- ⁴ *Want China Times*, “CCTV Military Commentator Responds to US Report on YJ-18,” April 18, 2015. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20150418000015&cid=1101>; Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Potent Vector: Assessing Chinese Cruise Missile Developments,” *National Defense University Press*, September 30, 2014. <http://ndupress.ndu.edu/Media/News/NewsArticleView/tabid/7849/Article/577568/jfq-75-a-potent-vector-assessing-chinese-cruise-missile-developments.aspx>.
- ⁵ U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2015*, May 2015, 10.
- ⁶ *IHS Jane’s*, “Jane’s Strategic Weapon Systems: C-801, C-802, C-803,” July 21, 2015.
- ⁷ *Want China Times*, “PLA’s YJ-18 Anti-Ship Missile Useful against US Carrier Group,” December 3, 2014. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20141203000057&cid=1101>.
- ⁸ Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Low-Visibility Force Multiplier: Assessing China’s Cruise Missile Ambitions,” *National Defense University*, 2014, 15. <http://ndupress.ndu.edu/Portals/68/Documents/Books/force-multiplier.pdf>.
- ⁹ *IHS Jane’s*, “Jane’s Strategic Weapon Systems: Yong Ji-18 (YJ-18),” June 5, 2015; *Want China Times*, “PLA’s YJ-18 Anti-Ship Missile Useful against US Carrier Group,” December 3, 2014. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20141203000057&cid=1101>.
- ¹⁰ *IHS Jane’s*, “Club (3M-14/3M-54/3M-54M1/91R1/91R2),” June 9, 2015; James C. Bussert, “China Destroyer Consolidates Innovations, Other Ship Advances,” *Signal*, December 1, 2013. <http://www.afcea.org/content/?q=china-destroyer-consolidates-innovations-other-ship-advances>; and China Aerospace Science and Industry Corporation, quoted in *Guancha* (China), “American Military Assesses the YJ-18 Missile to Be Closest to Perfect Antiship Missile,” April 9, 2013. Staff translation. http://www.guancha.cn/Science/2013_04_09_137481.shtml.
- ¹¹ Shane Bilsborough, “China’s Emerging C4ISR Revolution,” *Diplomat* (Japan), August 13, 2013. <http://thediplomat.com/2013/08/chinas-emerging-c4ISR-revolution/1/>.
- ¹² Ian Easton, “China’s Evolving Reconnaissance-Strike Capabilities: Implications for the U.S.-Japan Alliance,” *Project 2049 Institute*, 6–15. http://www.project2049.net/documents/Chinas_Evolving_Reconnaissance_Strike_Capabilities_Easton.pdf; Robert Haddick, *Fire on the Water: China, America, and the Future of the Pacific*, Naval Institute Press, 2014, 97.
- ¹³ Michael S. Chase et al., “China’s Incomplete Military Transformation: Assessing the Weaknesses of the People’s Liberation Army,” *RAND Corporation*, February 2015, 116–117.
- ¹⁴ U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2015*, May 2015, 35.
- ¹⁵ U.S.-China Economic and Security Review Commission, *Hearing on China’s Offensive Missile Forces*, written testimony of Dennis Gormley, April 1, 2015; Ian Easton, “China’s Evolving Reconnaissance-Strike Capabilities: Implications for the U.S.-Japan Alliance,” *Project 2049 Institute*, 20. http://www.project2049.net/documents/Chinas_Evolving_Reconnaissance_Strike_Capabilities_Easton.pdf.
- ¹⁶ *IHS Jane’s*, “Club (3M-14/3M-54/3M-54M1/91R1/91R2),” June 9, 2015; *IHS Jane’s*, “Jane’s Strategic Weapon Systems: Yong Ji-18 (YJ-18),” June 5, 2015; and Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Potent Vector: Assessing Chinese Cruise Missile Developments,” *National Defense University Press*, September 30, 2014. <http://ndupress.ndu.edu/Media/News/NewsArticleView/tabid/7849/Article/577568/jfq-75-a-potent-vector-assessing-chinese-cruise-missile-developments.aspx>.
- ¹⁷ Zachary Keck, “Can China’s Nuclear Submarines Blockade India?” *National Interest*, June 5, 2015. <http://nationalinterest.org/blog/the-buzz/can-chinas-nuclear-submarines-blockade-india-13053>; Press Trust of India, “China to Commission 3 Nuclear Submarines,” *Free Press Journal* (India), April 3, 2015. <http://www.freepressjournal.in/china-to-commission-3-nuclear-submarines/>; and Globalsecurity.org, “Type 093 Shang-class Nuclear Attack Submarine.” <http://www.globalsecurity.org/military/world/china/type-93.htm>.
- ¹⁸ *IHS Jane’s*, “Jane’s World Navies: China,” June 17, 2015; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 19; and *IHS Jane’s*, “Jane’s Fighting Ships: Shang Class (Type 093/093A),” February 13, 2015.
- ¹⁹ *IHS Jane’s*, “Jane’s Strategic Weapon Systems: C-801, C-802, C-803,” July 21, 2015.

- ²⁰ Franz-Stefan Gady, “Revealed: China’s New ‘Carrier Killer’ Sub Simulator,” *Diplomat* (Japan), May 8, 2015. <http://thediplomat.com/2015/05/revealed-chinas-new-carrier-killer-sub-simulator/>; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16.
- ²¹ *IHS Jane’s*, “Club (3M-14/3M-54/3M-54M1/91R1/91R2),” June 9, 2015; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2015*, May 2015, 46.
- ²² *IHS Jane’s*, “Jane’s Fighting Ships: Han Class (Type 091/091G),” February 13, 2015.
- ²³ Andrew Tate, “China Building Type 052Ds at Dalian,” *IHS Jane’s Defense Weekly*, May 13, 2015. <http://www.janes.com/article/51438/china-building-type-052ds-at-dalian>; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16; *Wanted China Times*, “PLA Could Be Developing Two Versions of Type 055 Destroyer,” April 6, 2015. <http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20150406000004&cid=1101>; and Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Potent Vector: Assessing Chinese Cruise Missile Developments,” *National Defense University*, September 30, 2014. <http://ndupress.ndu.edu/Media/News/NewsArticleView/tabid/7849/Article/577568/jfq-75-a-potent-vector-assessing-chinese-cruise-missile-developments.aspx>.
- ²⁴ Zachary Keck, “Chinese Aegis’ Leads A2/AD Drill in South China Sea,” *Diplomat* (Japan), October 3, 2014. <http://thediplomat.com/2014/10/chinese-aegis-leads-a2ad-drill-in-south-china-sea/>.
- ²⁵ Minnie Chan, “China’s Pirate Patrol Submarine Is Too Noisy, Say Naval Experts,” *South China Morning Post*, May 3, 2015. <http://www.scmp.com/news/china/diplomacy-defence/article/1784525/chinas-pirate-patrol-submarine-too-noisy-say-naval?page=all>; David Axe, “China’s Noisy Subs Get Busier — And Easier to Track,” *Wired*, December 27, 2011. <http://www.wired.com/2011/12/china-submarines/>.
- ²⁶ Robert Haddick, “China’s Most Dangerous Missile (So Far),” *War on the Rocks*, July 2, 2014. <http://warontherocks.com/2014/07/chinas-most-dangerous-missile-so-far/>.
- ²⁷ Dennis M. Gormley, Andrew S. Erickson, and Jingdong Yuan, “A Low-Visibility Force Multiplier: Assessing China’s Cruise Missile Ambitions,” *National Defense University*, 2014, 77. <http://ndupress.ndu.edu/Portals/68/Documents/Books/force-multiplier.pdf>.
- ²⁸ Andrew S. Erickson, “Showtime: China Reveals Two ‘Carrier-Killer’ Missiles,” *National Interest*, September 3, 2015. <http://nationalinterest.org/feature/showtime-china-reveals-two-carrier-killer-missiles-13769>; *IHS Jane’s*, “Jane’s Strategic Weapon Systems: C-801, C-802, C-803,” July 21, 2015; *IHS Jane’s*, “SS-N-22 ‘Sunburn’/Moskit/Moskit-M/Moskit-MV,” May 26, 2015; *IHS Jane’s*, “CSS-N-4 ‘Sardine’ (YJ-8/YJ-8A/C-801); CSS-N-8 ‘Saccade’ (YJ-82/YJ-83/C-802/C-802A/Noor/Ghader),” May 15, 2015; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2015*, May 2015, 10, 46; U.S. Office of Naval Intelligence, *The PLA Navy: New Capabilities and Missions for the 21st Century*, April 2015, 16, 24; *IHS Jane’s*, “YJ-62 (C-602),” March 30, 2015; *IHS Jane’s*, “Jane’s Strategic Weapon Systems: YJ-12,” January 22, 2015; *IHS Jane’s*, “Jane’s Strategic Weapon Systems: DF-21,” June 24, 2014; Christopher P. Carlson, “China’s Eagle Strike-Eight Anti-Ship Cruise Missiles: The YJ-83, C803, and the Family Tree,” *Defense Media Network*, February 8, 2013. <http://www.defensemedianetwork.com/stories/chinas-eagle-strike-eight-anti-ship-cruise-missiles-the-yj-83-c803-and-the-family-tree/>; and U.S. Office of Naval Intelligence, *The People’s Liberation Army: A Modern Navy with Chinese Characteristics*, 2009, 18.
- ²⁹ U.S.-China Economic and Security Review Commission, *Hearing on China’s Offensive Missile Forces*, written testimony of Dennis Gormley, April 1, 2015; U.S.-China Economic and Security Review Commission, *Hearing on China’s Offensive Missile Forces*, written testimony of Robert Haddick, April 1, 2015.
- ³⁰ *IHS Jane’s*, “Jane’s Missiles & Rockets: Orbital Launches 25th Coyote Supersonic Sea-Skimming Target,” August 11, 2011; *Economist*, “Missile Technology: Peril on the Sea,” June 10, 2010. <http://www.economist.com/node/1629552>.
- ³¹ James Hardy and Sean O’Connor, “IMINT Confirms Type 041 Visit to Karachi,” *IHS Jane’s*, July 8, 2015. <http://www.janes.com/article/52843/imint-confirms-type-041-visit-to-karachi>; U.S. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China 2015*, May 2015, 19.