

THE RACE TO THE BOTTOM

Submarine Proliferation and International Security

Jan Joel Andersson

The growing need to protect global shipping routes and the intensification of maritime territorial conflicts have led to a naval arms buildup around the world.¹ Perhaps the most-cited example of this new focus on naval power is the increasing number of countries building or planning new aircraft carriers, but many analysts are more concerned about the proliferation of modern attack submarines.² Often considered the ultimate weapon of naval warfare, submarines are versatile platforms able to attack surface ships, conduct antisubmarine warfare (ASW), deploy mines, and, as they are increasingly equipped with missiles, attack land targets.³ In addition, submarines are also highly capable intelligence-gathering platforms, able to monitor ship movements over vast distances, cut undersea communications cables, and insert reconnaissance teams covertly on hostile shores.⁴ Since submarines can operate without prior sea and air control, they allow a weaker actor means to attack a stronger one. Submarines also create uncertainty for an opponent, since the presence of an enemy submarine is difficult to confirm until an attack takes place. Countering a hostile submarine force is not only difficult but also very time consuming.⁵ Given such strong offensive capabilities, submarines are viewed as especially detrimental to crisis stability.⁶

Nevertheless, despite the rapidly increasing number of countries buying submarines and counter to conventional wisdom, I argue that the threat to international security from the current submarine proliferation around the world may have been exaggerated. In reality, it is very difficult and costly to operate submarines safely and even more difficult to create and sustain a submarine force capable of conducting effective combat patrols. Furthermore, the strategic value of a submarine force in comparison with other defense assets in times of limited budgets is not always self-evident, and some longtime operators of submarines

have even abandoned them in favor of larger surface vessels.⁷ In this article I analyze the threat to international security from the global proliferation of submarines by focusing on the challenges of maintaining boats and training crews. The article consists of three main sections: the first maps the global proliferation of submarines; the second analyzes the threat from this proliferation in terms of having enough submarines in a fleet, maintaining them, and training and retaining enough personnel; and the third concludes.

THE GLOBAL PROLIFERATION OF SUBMARINES

Given submarines' versatility, many navies around the world are currently procuring or actively contemplating the acquisition of new ones.⁸ Although the total number of submarines in the world has fallen since the height of the Cold War, mainly due to the retirement of large numbers of old Soviet and Chinese boats, the current global submarine inventory stands at over four hundred submarines operated by some forty countries (see the table).⁹ Of these some 390 are attack submarines or nonstrategic guided-missile submarines. It is estimated that more than 150 new submarines will be built by 2021 and that up to three hundred could be launched in the next fifteen to twenty years.¹⁰ According to industry sources, the global submarine market was valued at U.S.\$14.4 billion in 2013 and is expected to grow to \$21.7 billion by 2023.¹¹ Such longtime submarine builders and operators as China, France, Germany, Japan, Russia, Sweden, the United Kingdom, and the United States are all renewing their current fleets.¹² The main export markets are, however, in the Middle East, Asia, and Latin America. In these regions, many existing submarines from the Soviet era, as well as early German export models, are reaching the ends of their operational lives and need to be replaced. In addition, several navies without previous experience with the type are ordering submarines.¹³ National security is a main reason driving the demand for submarines in some areas, particularly in Asia, but domestic industrial and technological development goals, as well as national prestige, are also important factors.¹⁴

The submarine world used to be controlled by the great powers and a handful of technologically advanced countries, such as Germany, Japan, the Netherlands, and Sweden. Today, in contrast, submarine operators can be found on every inhabited continent, including Africa.¹⁵ In the Middle East, the navies of Algeria, Egypt, Iran, and Israel have submarines, while Oman, Saudi Arabia, and the United Arab Emirates are contemplating acquisitions.¹⁶ In Latin America too, Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Venezuela all have submarines, and several of them are in the process of adding to their fleets. In South Asia, India and Pakistan have long operated submarines and deployed them in war, while Bangladesh and Burma (Myanmar) are planning to procure submarines

in the near future.¹⁷ In Northeast Asia, Japan and South Korea are adding new submarines to already impressive fleets to counter China's and North Korea's very large submarine forces. In Southeast Asia, Australia, Indonesia, Malaysia, Singapore, Taiwan, and Vietnam all have attack submarines, and many plan new acquisitions.¹⁸ In addition, the Philippines and Thailand recently announced that they too are seeking to obtain submarines.¹⁹ Given that many of these countries are parties to territorial disputes and close to some of the world's busiest shipping lanes and maritime choke points, it is not surprising that the proliferating number of submarines around the world has many observers concerned.²⁰

There are not only more submarine operators than ever, but many of the boats they operate are also more sophisticated than ever.²¹ India recently joined, China, France, Russia, the United Kingdom, and the United States in the nuclear-powered-submarine club.²² Brazil may soon join too, as it has plans to build a nuclear-powered submarine in the coming decade.²³ While it does not enable submarines to match the underwater endurance of nuclear-powered boats, the increasing availability of air-independent propulsion (AIP) allows conventionally powered submarines to remain submerged for weeks rather than days.²⁴ Submarine manufacturers in France, Germany, and Sweden all offer this technology to prospective buyers around the world.²⁵ China may soon be added to this list; it is rumored that it may sell AIP-equipped submarines to Pakistan, though no technical specifications have yet been confirmed.²⁶ Another advanced technology increasingly being offered to global submarine customers by France, Russia, and the United States is that of submarine-launched antiship cruise missiles. Among recent buyers of cruise missiles for submarines are China, Egypt, India, Israel, Malaysia, Pakistan, South Korea, Taiwan, and Vietnam.²⁷ These new technologies, in combination with more sophisticated sensors, combat systems, and torpedoes, make today's submarines more capable and versatile than ever.

ANALYZING THE SUBMARINE THREAT

Reflecting the proliferation of submarines, the literature on the global naval arms buildup is dominated by descriptive accounts of the latest submarines acquisitions and procurement plans of navies around the world. These accounts are important indicators of armament trends but primarily focus on technical specifications of boats and details of their weapons systems.²⁸ Counting submarines is easy. It is far more difficult to evaluate the capabilities of a submarine force; rising numbers alone do not necessarily equate to a rising threat. In fact, few serious attempts are made to evaluate actual status or combat capabilities of the many submarine operators around the world.²⁹ Even in the large literature on the Chinese submarine program, most studies focus on equipment and overall strategy, rather

Country	Region	SSBN	SSGN	SSN	SSG	SSK/SS
Canada	North America					4
United States	North America	14	4	53		
France	Europe	4		6		
Germany	Europe					4
Greece	Europe					8
Italy	Europe					6
Netherlands	Europe					4
Norway	Europe					6
Poland	Europe					5
Portugal	Europe					2
Spain	Europe					3
Sweden	Europe					5
Turkey	Europe					14
Ukraine	Europe					1
United Kingdom	Europe	4		7		
Russia	Russia	11	8	17		20
Australia	Asia					6
China	Asia	4		5	1	60
India	Asia			1		13
Indonesia	Asia					2
Japan	Asia					18
North Korea	Asia					20
South Korea	Asia					12
Malaysia	Asia					2
Pakistan	Asia					5
Singapore	Asia					6
Taiwan	Asia					4
Vietnam	Asia					2
Algeria	Middle East / North Africa					4
Egypt	Middle East / North Africa					4
Iran	Middle East / North Africa					3
Israel	Middle East / North Africa					3

Country	Region	SSBN	SSGN	SSN	SSG	SSK/SS
Libya	Middle East / North Africa					2
Argentina	Latin America / Caribbean					3
Brazil	Latin America / Caribbean					5
Chile	Latin America / Caribbean					4
Colombia	Latin America / Caribbean					4
Ecuador	Latin America / Caribbean					2
Peru	Latin America / Caribbean					6
Venezuela	Latin America / Caribbean					2
South Africa	Sub-Saharan Africa					3
Total		37	12	89	1	277
Grand Total: 416						

Sources: *The Military Balance* (London: International Institute of Strategic Studies, 2014); U.S. Navy, "Submarine Proliferation Resource Collection," *NTI*, 21 October 2013, www.nti.org/.

than analyzing capability in terms of readiness of boats and training of crews.³⁰ These omissions lead to problems in correct assessment of the threat from the growing submarine forces around the world.

To deploy a submarine force effectively requires not only boats but the technical skills necessary to service and maintain them and enough trained personnel to operate them. Moreover, an effective submarine force requires means to communicate with boats and ability to control them once they deploy. These requirements are hard to fulfill and are far more complex than their application to surface ships.³¹

Minimum Numbers

An effective submarine force requires some minimum number of submarines. Because of the heavy maintenance requirements of submarines, it is generally held that at least four are necessary to keep one or two continuously on station or available for deployment.³² A smaller fleet will not provide enough opportunities for crew training, regular patrol deployments, or maintenance to sustain a capability over time. However, many of the world's submarine forces are very small, over a quarter smaller than that threshold size. Of the forty-two current operators, thirteen (see table) have fewer than four submarines (not counting coastal or midget submarines): Argentina (three), Ecuador (two), Indonesia (two), Iran (three), Israel (three), Libya (two), Malaysia (two), Portugal (two), South Africa (three), Spain (three), Ukraine (one), Venezuela (two), and Vietnam (two). Moreover, the submarines in several of these small forces are very old, reaching

the ends of their safe service lives. Argentina, Colombia, Ecuador, Indonesia, and Venezuela all operate thirty-to-forty-year-old submarines that are increasingly “maintenance heavy” and limited in their ability to go to sea. In a small fleet, this fact even further restricts opportunities for necessary crew training and patrol deployments. Some of these countries have recently ordered new submarines but in most cases will only replace existing boats without significantly increasing numbers. Some other submarine forces have four or more submarines but only on paper; in reality, many of their submarines are very old and in extended or even indefinite maintenance, seriously impacting the training and deployment of the remaining units.

Maintenance and Logistics

Owing to their taxing underwater environment, submarines are particularly challenging to keep operational. This is especially the case in the tropics, where higher salinity and temperature of seawater increase corrosion on equipment that in many cases was designed for much colder and less corrosive northern climates.³³ Modern submarines are complex systems of systems, requiring substantial skills in not only regular ship maintenance but also the upkeep of advanced propulsion and technology employed in acoustics, electronics, and periscope optics.³⁴ The catastrophic consequences of mechanical or equipment failure underwater require particular attention to quality control and regular maintenance. By no means all countries are capable of fully servicing and refitting modern submarines; many operators are forced to hire foreign help or send their boats abroad for extended periods of time and at great cost. Any deferment of regular service and refits quickly renders boats unsafe for operations.³⁵

Maintaining and servicing complex systems like submarines require both technical expertise and suitable shipyards. The challenges of maintaining submarines with inadequate support organizations can be illustrated by the experience of the South African navy and its German Type 209 submarines, a minor local overhaul of one of which commenced in 2007. Inadequate infrastructure and technical understanding of onboard electrical systems reportedly kept the boat out of commission for more than five years.³⁶ In August 2012, it was reported, all three of South Africa’s submarines were in dry dock, the only operational vessel having crashed into the seabed.³⁷ The problems of maintenance also increase when there are many different types of boats in a fleet.³⁸ The complexity of servicing the Indian submarine fleet—comprising German Type 209, Russian Kilo, Russian nuclear-powered Akula II, indigenously designed nuclear-powered boats, and soon also French *Scorpène*—must be daunting, to say the least. In fact, a lack of adequate domestic repair facilities and difficulties in obtaining spare parts have forced India to send many of its submarines to Russia for lengthy refits over the years.³⁹

Even long-established, single-class submarine services can have great difficulties in maintaining their boats. The Royal Australian Navy (RAN) currently operates six Swedish-designed *Collins*-class submarines that were coproduced in Australia and commissioned between 1996 and 2003. These boats, among the largest and most advanced conventional submarines in the world, have suffered from persistent maintenance problems that have resulted in reduced availability and opportunities for crew training. The RAN's stated goal is to have always two submarines deployed or available for immediate deployment, two in training, and two in maintenance. However, this goal has reportedly never been achieved;

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the navy has at times been left with only one operational submarine, sometimes none at all.⁴⁰

Many of the problems of the *Collins*-class submarines

are not design related but stem from a failure by the RAN to make adequate maintenance and logistical arrangements when they entered service.⁴¹ This early lack of attention to maintenance and logistics and subsequent failure to adopt processes for reliability control led to maintenance backlogs that greatly reduced the number of available submarines for the RAN. Despite improvements, the Australian submarine force still has problems with availability, and RAN submarines have reportedly had to withdraw from three recent international exercise deployments, among them RIMPAC 2012, because of technical problems.⁴² The failure of the RAN to establish adequate and comprehensive maintenance procedures for its submarines shows that even experienced operators with access to domestic comprehensive shipbuilding industries may have trouble keeping their fleets at sea.

Another case in point is Canada, whose current fleet of four *Victoria*-class submarines, bought secondhand from the United Kingdom, has since the boats' commissioning between 2000 and 2004 suffered ongoing mechanical problems and accidents. The Royal Canadian Navy has never had more than two of these boats in operational condition, sometimes none.⁴³ Servicing the boats has proved not only far more complicated than expected but also far more costly.⁴⁴ According to defense experts, shortsighted management decisions in the procurement process, such as failing to acquire sufficient spare parts or establish supplier relationships beforehand, have led to repeated and significant delays in restoring submarines to operational status.⁴⁵ The Canadian submarine fleet is at this writing expected to reach a steady state for the first time in late 2014, whereby three of its four submarines will be available for operations at any one time, on a rolling schedule. It will have taken more than a decade to reach this point.⁴⁶ According

to the Canadian navy, the four *Victorias* together managed to spend only around 1,300 days at sea over the ten-year period 2003–13.⁴⁷

Maintaining submarines is costly. Any submarine force lacking funds for maintenance and training will struggle to maintain any useful level of readiness. To get Canada's submarine force fully operational, the nation's Treasury Board approved in 2008 the expenditure of up to Cdn.\$1.5 billion over as many as fifteen years for the in-service support for the *Victoria* class. After a competitive bidding, the *Victoria* In-Service Support Contract was awarded to the Canadian Submarine Management Group, currently known as Babcock Canada, Inc.⁴⁸ In June 2013 the Canadian government extended the submarine maintenance and support contract with Babcock Canada, valued at Cdn.\$531 million, for another five years.⁴⁹

Given that submarines are among the most complicated machines in existence, maintaining them is of central importance. Rigorous and regularly scheduled maintenance periods are essential. Failure to include the costs of submarine upkeep in defense budgets may therefore be an indication of a low level of attention to the issue. As a case in point, in 2011 the Malaysian Ministry of Defence was awarded an additional allocation of RM 493.3 million (\$167 million) to maintain its two recently bought *Scorpène* submarines, raising the total defense budget to RM 11 billion (\$3.77 billion). Apparently the defense ministry had not allocated any funds to maintain or administer the submarines in the original budget.⁵⁰ Moreover, owing to the lack of necessary local technical expertise to service them, the Malaysian navy's two *Scorpènes* are now maintained by the French company Boustead DCNS Naval Corporation. According to press reports, Boustead provides full logistics support to the Malaysian navy—spare parts, workshop equipment, yard facilities and equipment, submarine safety conditioning facilities, support, and maintenance. The company even provides tugboat services and operates and maintains ship lifts, and submarine umbilical services (shore electrical power and the like).⁵¹

Submarine operators that do not have the required expertise or the funds to buy it on commercial terms are left to improvise. Iran, for example, has three Russian Kilo-class submarines but cannot afford, or does not dare, to send them back to Russia for refurbishment and upgrade. Russia refuses to provide necessary technical information and spare parts, so Iran has undertaken upgrades at home. Forced to complete refurbishments and repairs to one of its Kilos on its own, Iran relaunched it in 2012 after seven years in refit. According to Iranian press releases, replacement parts and components (pumps, compressors, engines, sound-absorbent tiles, control surfaces, etc.) were locally produced and installed.⁵² Some were commonly available, but many others were not. It is unknown how adequate the Iranian replacement parts have proved, but the fact

that it took Iran seven years to refit one submarine indicates how challenging it is to keep modern submarines at sea.

Maintenance and repair needs increase with age, as do difficulties in obtaining spare parts. Many submarines around the world are over thirty years old, some over forty. Both Colombia and Venezuela, for example, have 1970s-era Type 209s.⁵³ Taiwan's two World War II-era Guppy-type submarines are even older and can be used only for training purposes.⁵⁴ Indonesia's two Type 209 boats, bought from Germany in 1981, have been repeatedly refitted, but they are not to be replaced until 2020, at which time they will be forty years old.⁵⁵ Given the work required to keep such old boats running in tropical climates, their sea time must be limited and their safety an issue. Some submarine operators simply have run out of money and seem to do little maintenance or none at all. The Argentine navy as a whole is reportedly in disrepair owing to the absence of funds for maintenance and training. According to media reports, all three of its submarines have defects and barely left port in 2012.⁵⁶ Given the poor maintenance performance of many countries, the operational status of many submarine forces must be seriously questioned.

Training and Deployment

Operation of a submarine is very different from the case with a surface vessel. A submarine without a properly trained crew cannot do much more than sail in and out of harbor. Training submarine crews, however, is especially difficult and time consuming. To become qualified, a submariner needs between one and two years of intensive training; fully mastering some high-technology systems, such as advanced sonar, takes even longer.⁵⁷ It can take at least six years of training to make a crew a cohesive unit able to operate at sea effectively.⁵⁸ A submarine captain requires, to reach the highest skill levels, between ten and fifteen years of training and deployment. A submarine's crew, to remain qualified and maintain its skills, needs regular deployments. While surface sailors and officers can practice many of their skills on any surface vessel, a submarine crew can train effectively only on a submarine. Although simulators are becoming increasingly powerful, many submarine-related skills cannot be learned or maintained except during actual deployments.⁵⁹ A lack of training boats and shore facilities quickly atrophies skills. In navies having only one, two, or a handful of submarines, the availability of boats on which to train directly bounds the possibility of achieving trained crews and effective deployments.

In the U.S. Navy, with a large submarine fleet and a high operational tempo, submarine crews gain experience and maintain skills from repeated and extended deployments. Other highly regarded submarine services are, for example, the British, Dutch, German, Japanese, and Swedish. Two common traits among these services are focus on maintenance and close relationships with original design

firms and building yards, as a result of which their boats can be used effectively for training and deployment. For these submarine services, a greater challenge is to recruit and retain enough personnel. The shortage of personnel means that, for example, British submarines regularly leave for deployments with less than full crews; that only three of the Dutch navy's four submarines can be fully manned; and that the Swedish navy would be able to send its five submarines to sea simultaneously only by drawing on submarine-qualified personnel assigned to central staff and shore duties.⁶⁰

In fact, many if not most submarine services around the world suffer from recruitment problems. South Korea and Taiwan both have difficulty recruiting and retaining submariners.⁶¹ The Australian navy is so short of submariners that it can find crews for only three or four of its six boats and actively seeks recruits from overseas.⁶² The South African navy needs about 150 submarine-qualified sailors to form full-time crews for its three boats, but over the last several years it has had enough sailors to operate only one. Moreover, owing to high operating expenses and a lack of funds, the ships and submarines of the South African navy spend a very limited amount of time at sea. On 17 July 2012 the South African submarine SAS *Queen Modjadji* collided with the ocean floor during an exercise because of what a member of parliament described as negligence and poor training.⁶³ Since the other two South African submarines were in long-term maintenance, the crash put the country's entire submarine fleet in dry dock simultaneously, effectively precluding training.⁶⁴ In Latin America, many submarines are in a poor state, resulting in little or no training for crews. According to one report, Argentina's submarine crews spent only nineteen total hours submerged in 2011.⁶⁵

All submarine services experience incidents and accidents, but with inexperienced crews minor incidents are more likely to have fatal consequences. A case in point is the Indian navy, where personnel shortages have plagued the submarine service since its inception in the 1960s. Rapid introduction in a short time of large numbers of submarines from different countries, while simultaneously setting up shore support facilities, made recruitment difficult.⁶⁶ Selection procedures had to be made less stringent, and pay was increased several times. According to naval historians in India, it was only in the 1990s that the Indian navy began to attract personnel of the desired caliber to submarines.⁶⁷ Even today, despite increases in pay, the Indian submarine service seems to suffer from training and maintenance problems.⁶⁸ In August 2013, explosions sank INS *Sindhurakshak* (a Russian-built Kilo) in Mumbai Harbor, killing its crew of eighteen; the cause, according to preliminary findings, was an accident with or mishandling of ammunition by inexperienced crew members in the weapons compartment.⁶⁹ Another possible explanation for the catastrophic explosion is,

according to Russian experts, a violation of safety standards and instructions by the crew during the recharging of the submarine's batteries.⁷⁰ The *Sindhurakshak* disaster and subsequent publicity in Indian media on the harsh living conditions on board Russian-built submarines will hardly make future recruitment any easier for the Indian submarine service.⁷¹

All established submarine services conduct their own training. Some cooperate and send students to each other's schools. The Australian and Canadian navies, for example, both collaborate with Britain and the United States in submarine training. Joint submarine training is also common within NATO.

The threat to international security from the current submarine proliferation around the world may have been exaggerated.

The British and Dutch advanced "Perisher" courses for prospective submarine commanders are increasingly open to other friendly nations'

submarine communities. Students from Australia, Brazil, Canada, Denmark, Norway, Singapore, South Korea, and the United States have all participated in these legendary courses.⁷²

However, navies with little or no previous submarine experience must seek training elsewhere. All major exporters of submarines provide some degree of training to their customers. There is little available information on such programs, but they seem to last between six months and four years, depending on the nations involved. Sometimes such training is organized by the host navies; in other cases the companies building the submarines are in charge. The level of training also depends on the quality of crews sent. Two of the biggest purveyors of submarine training of this kind are France and Russia.

Malaysia is the most recent beneficiary of French submarine training. In January 2005, 156 Malaysian sailors began a program in France that included at-sea training on a retired French navy *Agosta*-class submarine. In December 2005, twenty-three crew members qualified as submariners, and in January 2009, after four years of training, the first Malaysian submarine crew became operational. Information on the level of Malaysian submarine training is scant, but it is known that the Malaysian navy has long-standing problems recruiting qualified sailors and coping with technologically advanced systems.⁷³ In this case, after the Malaysian submarines were brought home, local sea trials were repeatedly delayed, owing to technical and maintenance problems. The submarines have reportedly been unable at times to conduct basic diving exercises, and they have been criticized for not being deployed.⁷⁴ Malaysia has since turned to DCI, a French company, which is participating in the creation and running of a submarine school at the Kota Kinabalu base in Malaysia.⁷⁵

Russia is providing training to its many submarine customers in both the Baltic Sea and in the Far East. Russian submarine training heavily emphasizes classroom teaching and dockside drills.⁷⁶ Because Russian submarines have shorter design life spans than Western boats, Russian-trained crews spend less time at sea, to minimize wear and tear on components and equipment. Also, foreign officers are apparently given command of their boats after comparatively little sea time. The first Vietnamese sailors arrived in Russia in January 2013, with no experience with the type, to begin the theoretical part of their submarine training.⁷⁷ Sea training was conducted near Kaliningrad, on the Baltic Sea, in April and May 2013 and included “five 10-days [*sic*] sea voyages,” according to press reports.⁷⁸ The first boat was officially accepted by the Vietnamese navy on 15 January 2014, and its crew began to operate it, after some ten total months of submarine training.⁷⁹

Vietnam lacks a domestic submarine training school; India has offered to train Vietnamese sailors at its own. Even with sustained Russian and Indian support, however, there are major questions regarding the ability of Vietnam to develop a fully functioning submarine force over the coming years.⁸⁰ Moreover, it is far from clear how these submarines will communicate and fit together with all the other new ships and aircraft Vietnam is currently acquiring from Russia, the Netherlands, Canada, and France. Given the Vietnamese military’s limited experience operating each of these platforms even separately, industry analysts predict that Vietnam will fall somewhere between Singapore (at the high end) and Indonesia (at the low end) in ability to create eventually an effective submarine capability.⁸¹

COMPLICATED AND COSTLY

There is a great concern among many defense analysts that the rapid spread of submarines around the world will threaten international crisis stability. More countries than ever are fielding submarines, but it is less than clear that the risk of conflict and war has increased thereby. In this article I argue that the threat from the growing number of submarines around the world may have been overstated. At the very least, the available evidence indicates that building up and maintaining an effective submarine force are far more complicated and costly than is commonly understood. By examining maintenance facilities and logistics organizations we learn that many countries are not able to keep their boats safely at sea. Having few submarines available, they cannot properly train their crews; the costly mistakes and deadly accidents that result leave even fewer boats and personnel for actual deployment.

Accordingly, any assessment of the strategic threat posed by submarine proliferation should focus on the effectiveness of submarine forces’ maintenance and

logistics organizations, the quality of their recruitment and training processes for crew and commanders, the rates of deployment, and the numbers of patrols conducted. Many of the world's navies are finding it hard to maintain and service their submarines properly or even to recruit and retain qualified personnel, and these services have little opportunity to conduct enough patrols to give their crews the operational experience necessary to deploy effectively.

However, any evaluation of a submarine threat must also take available anti-submarine warfare capabilities into account.⁸² Hunting submarines is difficult and time consuming. Even advanced navies find ASW taxing; as the British discovered during the Falklands War, locating even an old and poorly operated submarine can be a challenge.⁸³ Nevertheless, the very presence of advanced ASW capabilities can be expected to have a deterring effect on a hostile submarine force. For example, during the East Timor crisis in late 1999, Indonesia's two submarines shadowed the fleet carrying the Australian-led peacekeeping force toward Dili. The presence of Indonesian submarines obliged the force to intensify the protection of its sea lines of communications and step up the ASW operations of the escort group of frigates, a destroyer, a cruiser, and ASW patrol aircraft.⁸⁴ However, once the Indonesian submarines had been detected and their locations clearly communicated to the Indonesian authorities the submarines withdrew from the area rather than facing the escorting warships.⁸⁵ (This incident is, of course, also a reminder that any maritime force protection ought to include advanced ASW capabilities, which means that ASW needs to be maintained and further developed as a naval core competency.)⁸⁶

While, then, even poorly operated and maintained submarines can never be completely discounted as threats to international security, we should nevertheless be mindful of the very significant challenges facing many submarine forces around the world. The conclusion is therefore that the general threat to international security from the growing number of submarines appearing in annual naval reviews around the world should not be exaggerated; instead, each case must be carefully examined.

NOTES

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The Indian Ocean and International Security (Washington, D.C.: Georgetown Univ. Press, 2013); James Goldrick and Jack McCaffrie, *Navies of South-East Asia: A Comparative Study* (New York: Routledge, 2013); and Geoffrey Till, *Asia's Naval Expansion: An Arms Race in the Making?*, Adelphi Series (New York: Routledge, 2012).

2. See, for example, John R. Benedict, "The Unraveling and Revitalization of U.S. Navy Antisubmarine Warfare," *Naval War College Review* 58, no. 2 (Spring 2005), pp. 93–120; Lyle Goldstein and William Murray, "Undersea Dragons: China's Maturing Submarine Force," *International Security* 28, no. 4 (Spring 2004), pp. 161–96; and Jean Grace, "Diesel-Electric Submarines, the U.S. Navy's Latest Annoyance," *National Defense Magazine* (April 2008), pp. 1–6.
3. Stephen Saunders, *Jane's Fighting Ships 2013–2014* (Coulsdon, Surrey, U.K.: IHS Jane's, 2014); Eric Wertheim, *The Naval Institute Guide to Combat Fleets of the World: Their Ships, Aircraft, and Systems*, 16th ed. (Annapolis, Md.: Naval Institute Press, 2014); James P. Delgado, *Silent Killers: Submarines and Underwater Warfare* (Oxford, U.K.: Osprey, 2011); Nicholas Whitestone, *The Submarine: The Ultimate Weapon* (London: Davis-Poynter, 1973).
4. Sherry Sontag and Christopher Drew, with Annette Lawrence Drew, *Blind Man's Bluff: The Untold Story of Cold War Submarine Espionage* (London: Arrow Books, 2000).
5. Benedict, "Unraveling and Revitalization of U.S. Navy Antisubmarine Warfare."
6. Charles A. Meconis and Michael D. Wallace, *East Asian Naval Weapons Acquisitions in the 1990s: Causes, Consequences, and Responses* (Westport, Conn.: Praeger, 2000), pp. 63–64; Sontag and Drew, *Blind Man's Bluff*.
7. Denmark, for example, disbanded its ninety-five-year-old submarine service in 2004. In a strategic choice to focus more on expeditionary operations overseas and less on territorial defense, the Danish government decided to concentrate its naval resources on oceangoing frigates rather than coastal submarines. Danish Ministry of Defence, "Agreement Regarding Danish Defence," Liberals–Conservatives–Social Democrats–Danish People's Party–Social Liberals–Christian Democrats, 10 June 2004, available at www.fmn.dk/.
8. "Submarine Proliferation Resource Collection," *NTI* [Nuclear Threat Initiative], 21 October 2013, pp. 1–3, www.nti.org/. The number of submarines in the world rapidly rose during the Cold War as the United States and the Soviet Union built up their fleets, then diminished; James Clay Moltz, "Submarine and Autonomous Vessel Proliferation: Implications for Future Strategic Stability at Sea" (U.S. Naval Postgraduate School, Monterey, Calif., December 2012), pp. 8–9. The number of countries operating them has increased.
9. "Snapshot: The Global Submarine Market 2011–2021," Naval-Technology.com, 9 June 2011, www.naval-technology.com/; "South American Submarine Industry Set to Grow," *UPI: Business News*, www.upi.com/.
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Dr. Andersson is Senior Analyst at the European Union Institute of Security Studies in Paris. This article was written while he was Dragas Distinguished Visiting Professor in the Graduate Program of International Studies at Old Dominion University, in Norfolk, Virginia, on leave from the Swedish Institute of International Affairs, in Stockholm. Dr. Andersson received his PhD in political science from the University of California, Berkeley, and has taught at Berkeley and the Universities of Stockholm and Uppsala in Sweden, as well as at the Swedish National Defense College.