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A “NEW LOOK” AT COLD WAR MARITIME DEFENSE

The Royal Canadian Navy’s *Seaward Defence Report* and the Threat of the Missile-Firing Submarine, 1955

Michael Whitby

Antisubmarine warfare (ASW) during the First and Second World Wars featured a relentless struggle of measure versus countermeasure as opposing forces sought a decisive edge. Examples abound from both world wars: unrestricted submarine warfare bred convoys; surface attacks by submarines spawned Q-ships; hull-mounted sonar triggered night surface attacks by U-boats; the so-called Black Pit in the North Atlantic demanded very-long-range (VLR) patrol aircraft; acoustic homing torpedoes begot towed decoy noisemakers; and so forth. Some measures required immediate response, while others induced more-subtle reactions; some required strategic adjustments, while others could be met by innovative tactics.

The measure-countermeasure pattern continued into Cold War ASW, during which improvements to the performance, sensors, and weaponry of submarines forced bold counterstrokes. One of the most significant challenges to Allied antisubmarine (A/S) forces during this so-called Third Battle arose in the mid-1950s with the receipt of intelligence that the Soviets were developing the capability to launch nuclear-armed missiles from conventional submarines. In 1956, the U.S. Navy’s Project Nobska—a group of scientists, academics, and naval personnel tasked with investigating trends in ASW—explained the problem as follows:

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“Confronted with quiet submarines of long endurance, a sufficiently accurate means of navigation, and suitable weapons, a defense against shore bombardment by submarines becomes a huge problem. Even the partial defense of a long coastline requires a very large effort.”¹

The U.S. Navy and the Royal Canadian Navy (RCN) arguably were the Allied navies that the missile threat impacted most. During the first years of the Cold War, the Atlantic Ocean had provided a moatlike buffer against maritime nuclear threats. Soviet strategic bombers could reach North America, but direct nuclear attack from the sea was thought to be beyond the Soviets’ capability. That changed when naval intelligence organizations forecast that the Soviets would have the capability to deploy missile-firing submarines (SSGs) within range of North American targets as soon as the late 1950s.² The prospect of enemy missile boats lurking within range of American and Canadian defense installations and population centers—a Cold War PAUKENSCHLAG, or *Барабанный Бой*, if you will—alarmed naval planners.³ Particularly troubling would be attacks on the bases and command centers of the Strategic Air Command (SAC), which was charged with delivering a nuclear response.

SSGs were a game changer, and planners and operators scrambled to develop countermeasures. In the spring of 1955, the RCN’s initial response was enunciated in the only recently declassified *Seaward Defence Report*. Described by one officer as a “new look” at the maritime threat confronting Canada, the study concluded that then-emerging sound-surveillance systems were the key to countering SSGs, and it enunciated the types of forces that should be used to supplement the systems and how they should be employed.⁴ In short, the *Seaward Defence Report* provided a blueprint for how to conduct seaward defense in the nuclear age.

The report is an invaluable historical tool. It reveals how a midsize navy with comparatively limited resources charged with defending a long coastline and valuable strategic targets proposed to cope with dramatically changing circumstances. It also shows what Canadian naval planners understood about the nature of the Soviet threat in the mid-1950s, as well as their ability to counter it, *at the moment* they confronted the challenge. And it demonstrates how they sought to use these circumstances to further their ambitions. Importantly, the report also allows a peek at probable American thinking, since the almost seamless cooperation that then existed between the RCN and the U.S. Navy suggests that their plans may have been similar. Finally, examination of follow-on exercises allows testing of the report’s hypothesis. The *Seaward Defence Report*, then, presents an intriguing case study of how Cold War naval planners adapted to Soviet offensive innovations in the maritime sphere.

THE HISTORICAL AND STRATEGIC CONTEXT

In the mid-1950s, Canadian planning revolved around overlapping maritime defense partnerships in the North Atlantic. (While the Pacific was not ignored, the North Atlantic dominated thinking.) Since Canada was a founding member of the North Atlantic Treaty Organization (NATO), the RCN had obligations to the Supreme Allied Commander Atlantic (SACLANT), including responsibility for the Canadian Atlantic Sub-Area (CANLANT). The SACLANT commitment was a cornerstone of RCN planning.

However, this relationship was matched, and occasionally overshadowed, by Canada's close defense partnership with the United States. Since the 1940 Ogdensburg Agreement, Canada and the United States had cemented their military cooperation through vehicles such as the Permanent Joint Board on Defense and the Military Cooperation Committee. The relationship was not allowed to wither after the war, and in February 1947 the two countries announced their intention to continue with joint cooperation for continental defense. Demonstrating the intimacy of the partnership, that August the RCN's Director of Naval Plans noted that "in view of the vital importance of the defense of North American war making ability in a future war, RCN planning will in future be largely based on the Naval forces now envisaged in the [U.S./Canada] Basic Security Plan. This will make desirable the standardization of the RCN and the USN by the time that the Basic Security Plan must be ready for immediate implementation."⁵

The creation of NATO in April 1949 led to the establishment of the Canada-U.S. Regional Planning Group (CUSRPG), which functioned in part as a liaison between the two North American navies and other NATO forces under SACLANT. Importantly, although CUSRPG was part of NATO, for security reasons the United States and Canada often were unwilling to share the details of continental defense with European allies, in particular regarding information about sound-surveillance systems.⁶ Beyond these relationships, the RCN preserved its umbilical cord with the Royal Navy (RN), although the U.S. Navy was emerging as Canada's predominant maritime partner.

In the mid-1950s, the RCN was in the early stages of a substantial modernization of its A/S assets. The destroyers and frigates that formed the backbone of the postwar fleet were British designs of Second World War vintage.⁷ Destroyer strength consisted of seven Tribal-class and two each of the *Valentine*- and *Crescent*-class intermediate designs; two of the latter had their A/S capability significantly enhanced through a conversion similar to the Royal Navy's Type 15 program, while another seven underwent the more limited Type 16 upgrade.⁸ Sixteen River-class frigates were scheduled to undergo the *Prestonian* conversion, which, like the destroyer modernization, provided significant upgrades to their

sonar, radar, weaponry, and other systems. The RCN's lone aircraft carrier, the light fleet carrier (CVL) *Magnificent*, also was of Second World War design, as were its Grumman A/S-3 Avenger and Hawker FB-11 Sea Fury aircraft. These ships and aircraft could prosecute moderately fast submarines but were challenged by improved types with performance similar to those undergoing the U.S. Navy's new Greater Underwater Propulsion Power Program (i.e., GUPPY) conversions.⁹

However, enhanced capability was on the horizon. As part of the increase in defense spending that came with the escalation of the Cold War in the late 1940s, the RCN was building seven *St. Laurent*-class destroyer escorts, with seven similar *Restigouche*-class ships to follow. Scheduled to begin commissioning in 1955, these ships ultimately would be considered among the finest A/S platforms in the world. The new destroyers were to be accompanied by ships of the recently approved *Vancouver*-class frigate program, which was intended to provide replacements for the *Prestonians* as oceangoing escorts. In addition, the significantly modernized CVL HMCS *Bonaventure*, equipped with advanced angled-deck, mirror-landing, and steam-catapult systems, was due to commission in 1956, with an air group composed of Grumman CS2F Tracker A/S aircraft and McDonnell F2H-3 Banshee fighters.¹⁰ Strides also were being made in the development of ASW helicopters. Submarine strength was limited to two A-class boats on loan from Britain's Royal Navy. The fleet was rounded out by the light cruisers *Ontario* and *Québec*, which were used as training ships and designated for reserve if war broke out, as well as a cadre of minesweepers. Although the fleet possessed the elements of a balanced capability, ASW was the RCN's primary focus, and the planners mulling over new concepts in naval warfare in the spring of 1955 did so with the confidence that they were working from the basis of an increasingly effective A/S component.¹¹

Under the SACLANT war plans in place in the mid-1950s, if conflict erupted Canada's most potent A/S assets would be deployed immediately away from home waters to the eastern Atlantic (EASTLANT) under the NATO strategy emphasizing support to Europe. The aircraft carrier and fifteen escorts would head overseas to form the nucleus of a joint RCN/RN A/S hunting group based in Brest, France. The remaining oceangoing escorts were committed to the protection of the transatlantic shipping that would reinforce Europe. Only minesweepers would be allocated to Canadian waters, with the *Algerine* class escorting coastal convoys while the smaller *Bangor* and *Bay* classes fulfilled local minesweeping tasks.¹²

Although the Canadian government recognized that circumstances might preclude the deployment of the core of its A/S strength overseas, the European commitment remained paramount. But the new notions associated with seaward defense would challenge that policy.

THE SEAWARD DEFENCE REPORT

The *Seaward Defence Report* originated from a December 1954 request from the Chiefs of Staff Committee that the navy investigate “the nature and extent” of Canada’s seaward defenses at various stages of a war at sea. The focus was to be on the period 1958–62 and, reflecting NATO’s conception of a two-stage war—opening with a thirty-day nuclear exchange, followed by a period of conventional warfare—it was to examine requirements “on M-day, M plus 30 days, and after M plus 30 days.”¹³

This spawned the Seaward Defence Committee, composed of the senior officers at the head of the warfare and planning branches at Naval Service Headquarters (NSHQ) in Ottawa. The Assistant Chief of Naval Staff (ACNS) (Plans), Commodore D. L. Raymond, led the group, with the ACNSs (Warfare) and (Air), Commodores Kenneth L. Dyer and W. L. M. Brown, respectively, and the Director of Naval Plans and Operations (DNPO), Captain William M. Landymore, the other members. A working group chaired by Landymore, with officers from NSHQ’s antisubmarine, aviation, communications, and navigation directorates, did the spadework preparing the numerous specialized studies that formed the backbone of the report.¹⁴

Taking four months to complete, the study ultimately spanned some two hundred pages, including twenty-eight papers and thirteen annexes. Tight security shrouded the report, which was protected on a strict need-to-know basis owing to the “special security regulations” that protected information pertaining to sound-surveillance systems.¹⁵

THE CONCEPT

The “new look” was driven by the nature of the threat that would confront the RCN at the end of the decade. On the basis of shared intelligence, including “current American Canadian Agreed Intelligence papers,” it was acknowledged that in the 1958–62 time frame the Soviets would have the capability to attack the Canadian coast with aircraft, surface forces, and submarines.¹⁶ The report graded these threats from “improbable” to “probable,” as follows:

- (a) The following forms of attack are considered *improbable*:
 - (i) Attack by surface forces, by virtue of almost certain prospect of detection and destruction
 - (ii) Attack by air on maritime targets other than major ports, due to there being other targets of greater strategic importance
 - (iii) Attack inside local defenses by oceangoing submarines, due to the greater risk of detection

- (b) The following forms of attack are considered *possible*:
 - (i) Commando-style attacks launched from submarines outside local defenses
 - (ii) Attacks by small battle units launched from submarines outside local defenses
 - (iii) Minelaying by clandestine means in approaches to defended areas
- (c) The following forms of attack are considered *probable*:
 - (i) Torpedo attacks from submarines on coastal convoys, in focal areas or on coastal routes
 - (ii) Minelaying from submarines on coastal shipping routes in focal areas and harbor approaches
 - (iii) Minelaying from submarines in approaches to defended areas
 - (iv) Missile attacks launched from submarines
 - (v) Air attacks on the major ports¹⁷

With the exception of missile attacks by submarines and air attacks on major ports, these threats fell within the bounds of the traditional and were almost identical to assessments made during the Second World War. Giving priority to the probable threats and acknowledging the primary responsibility of the Royal Canadian Air Force (RCAF) for air defense, the *Seaward Defence Report* zeroed in on the submarine threat.¹⁸ It enumerated three main naval tasks:

- (i) To deny enemy submarines access to waters from which they can effectively launch guided missiles
- (ii) To provide protection to shipping within the Canadian coastal areas against submarine attack
- (iii) To provide protection to Canadian harbors and approach channels against penetration and all forms of attack from enemy submarines¹⁹

Given the gravity of the threat, the report was concerned mainly with missile-firing submarines. The RCN estimated that by 1960 the Soviets would be capable of deploying eight long-range submarines to the Atlantic coast and six to the Pacific coast, and they accepted British intelligence that the “Z” or Zulu-class long-range boats would be capable of launching missiles. On this basis they determined that the “most recent estimate available of the capability during the period under review is that submarines will be able to launch a missile a distance of 500 miles and that they will be able to control over 200 miles. A second submarine operating in conjunction with the launching submarine could increase the controlled range to 400 miles.”²⁰

Interestingly, even though USS *Nautilus*'s initial exploits were well known, the report made no reference to nuclear-powered submarines and the immense capability they might bring to strategic or A/S roles.²¹ Regarding the missiles SSGs would carry, intelligence sources concluded that the Soviets "had available an improved V-1 type with a high explosive warhead" and "a larger twin pulse Jet V-1 type." Moreover, it was understood that the Soviet Union "had reached a point in weapon technology at which it was capable of producing a *wide variety of weapon types and nuclear weapons for weapons other than bombs.*"²² The threat from the sea was serious: "The improved range, speed, and accuracy of the subsonic pilotless aircraft, which could be ready for mass production in 1955, would greatly increase the number of good targets for submarine-launched attack. In about 1958 the estimated nuclear warhead yield will approach compatibility with the estimated accuracy of the weapon system and would greatly increase the likelihood of its use against such targets as air bases and coastal port facilities."²³ With the possible exception of the number of boats the Soviets would be able to deploy to North American coasts by 1960, these estimates proved accurate.²⁴

COURSES OF ACTION

So, what to do? The challenge for A/S forces was driven by the necessity to destroy SSGs before they launched their missiles; the value of dispatching them afterward paled in significance. The hunt was made more difficult because A/S forces were seeking individual, free-ranging submarines that were attempting to evade detection, instead of ones lying in wait for convoys or patrolling established shipping lanes—there would be no "flaming datum" of the traditional variety.²⁵ Complicating the problem was that since the Canadian seaward-defense zone now would extend to the range of sound-surveillance systems (i.e., hundreds of miles out to sea) the area to be defended would expand by thousands of square miles—and this in the notoriously poor oceanographic conditions of the Canadian northwest Atlantic. The conventional solution would be to use carrier hunter-killer (HUK) groups or long-range maritime-patrol aircraft (MPA)—conventional submarines dedicated to ASW (designated SSKs) were just coming into their own—but without the advantage of intelligence like that provided by direction finding and ULTRA during the Battle of the Atlantic the task of finding individual submarines in the vast, open ocean would be difficult indeed.²⁶

For Canada's senior naval planners, the solution to this complex A/S problem lay with pioneering sound-surveillance systems. These, it was thought, would "give the earliest possible warning of impending attack" and "enable our forces to locate and destroy the attackers."²⁷ Although the systems were still in the early stages of development, Canadians had familiarity with them through informational exchange agreements with both the Americans and the British. Moreover,

in November 1952 the U.S. State Department had approached Canada for permission to site a surveillance station on Sable Island off Nova Scotia to fill a gap in the planned network along the Atlantic seaboard. After initial surveys revealed Sable Island to be unsuitable, the two countries agreed to build a facility at Shelburne on Nova Scotia's south coast.²⁸

A high-level report described what became known as Station Fox: "The Sound Research Station at Shelburne is planned to consist of an array of special devices laid on the ocean floor in 1,000 fathoms of water, approximately 100 miles at sea, with a tail cable laid from the array to Shelburne, where the equipment and personnel would be housed. In addition to the deep water array, a shallow water array is being laid for the purpose of research into the conditions met in cold, shallow waters peculiar to the Canadian coastal areas."²⁹

Embracing the promise the technology represented, RCN planners made it the foundation of the philosophy espoused in the *Seaward Defence Report*. The new seaward-defense concept envisioned a combination of two sound-surveillance systems. Under the designations then used by Canadian naval planners, these were the LOFAR (for *low-frequency analysis and recording*) system, developed by the Americans, and the CORSAIR (for *co-relation of sound analysis and recording*) system under initial investigation in the United Kingdom.³⁰ The LOFAR system enabled the detection of submarines through the capture of low-frequency acoustics by arrays of hydrophones extending far out to sea on the ocean floor. The arrays were connected to naval shore facilities where the acoustic data were analyzed digitally, with any resultant target data passed to operational headquarters for prosecution. In 1950, personnel involved with the U.S. Navy's Project HARTWELL, which was investigating the viability of a long-range acoustic detection system, recommended the detection of submarines by using real-time spectral analysis of radiated sound energy as holding the most promise for a future A/S detection system. That November, the Western Electric Company was contracted to develop the technology; it assigned the work to its research organization at Bell Telephone Laboratories. Work proceeded quickly and the first operational evaluation began in April 1952, with a forty-hydrophone array installed in two hundred fathoms from Eleuthera in the Bahamas. The test proved so successful that the U.S. Navy immediately called for the establishment of a nine-station chain along the eastern coast of the United States, including the future Station Fox.³¹

The British CORSAIR system was more of an unknown. The Admiralty Research Laboratory had begun to work it up only in 1952 and oceanographic evaluation still was under way, so the *Seaward Defence Report* acknowledged that it was in "its very earliest stages for which no evaluation information is available."³²

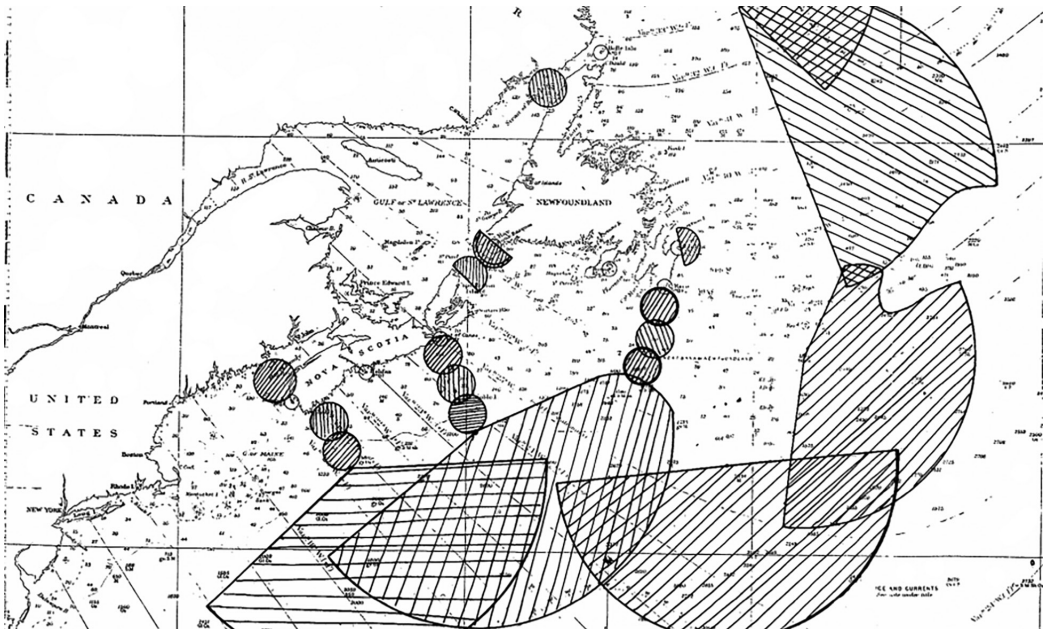
The *Seaward Defence Report* explained the differences between the two systems. The LOFAR system was "a network of surveillance stations strategically sited over the ocean approaches to the Coast," built to form "a surveillance belt which will detect and locate snorkeling submarines and thereby assist the ASW forces in the protection of coastal shipping and defense against submarines capable of launching attack weapons against the mainland." Spread evenly along the coast, the stations of the network would form "a surveillance belt about 500 miles to seaward." Performance would be affected by many variables, including oceanography and the topography of the ocean floor; however, "ranges against snorking submarines up to 500 miles may be experienced under favorable conditions on some bearings while on others it might not exceed 150 miles."³³ The systems would produce the best results against snorkeling boats; "[s]hould the submarine be on the surface or proceeding [submerged] on main motors, the detection capability is drastically reduced." CORSAIR, on the other hand, "has been developed to determine the accurate location of submarines in comparatively shallow waters off the North Western European continental shelf by means of hydrophones connected to a shore station." Expected ranges were far less than for LOFAR; preliminary evaluation indicated that "a submarine may be detected snorking out to ranges of 50 miles" and "a submerged submarine doing 4 knots on motors has been detected up to ranges of 10 miles." Bearing accuracy would be superior; however, unlike LOFAR, which could identify individual submarines by their unique "signatures," CORSAIR would be unable to provide specific target-classification information.³⁴

The report concluded that one system could backstop the other. The authors envisioned an overlapping network of LOFAR and CORSAIR installations.

With LOFAR, the U.S. Navy proposed siting stations two hundred miles apart to cover the required area and provide a degree of overlap to enable cross bearings to be obtained for contacts. Following that model—the only one in existence, after all—and taking "known conditions" into account, the Canadian report projected a network of five LOFAR arrays on the Atlantic coast, to be located off Sable Island; the southern and eastern extremities of the Grand Banks; Bonavista Bay, Newfoundland; and Hamilton Inlet, Labrador (see map 1). Some of these requirements already had been addressed: Station Fox at Shelburne covered the area seaward of Sable Island, and the RCN was aware of U.S. plans to site a shallow-water station at Argentia, Newfoundland, to cover the southern Grand Banks. The three arrays required on the Pacific coast would be located off Cape Cook at the northwest extremity of Vancouver Island and at Cape Saint James and Cape Knox at the southern and northern points of the Queen Charlotte Islands (see map 2).³⁵

Shallow-water CORSAIR arrays would provide "a 'road block' inside the coverage obtained by the long range LOFAR system."³⁶ The report did not specify

MAP 1 THE PROPOSED EAST COAST SOUND-SURVEILLANCE SYSTEM



The large arcs represent LOFAR coverage; the small circles depict CORSAIR coverage.

Source: CNS, "Underwater Surveillance Requirements."

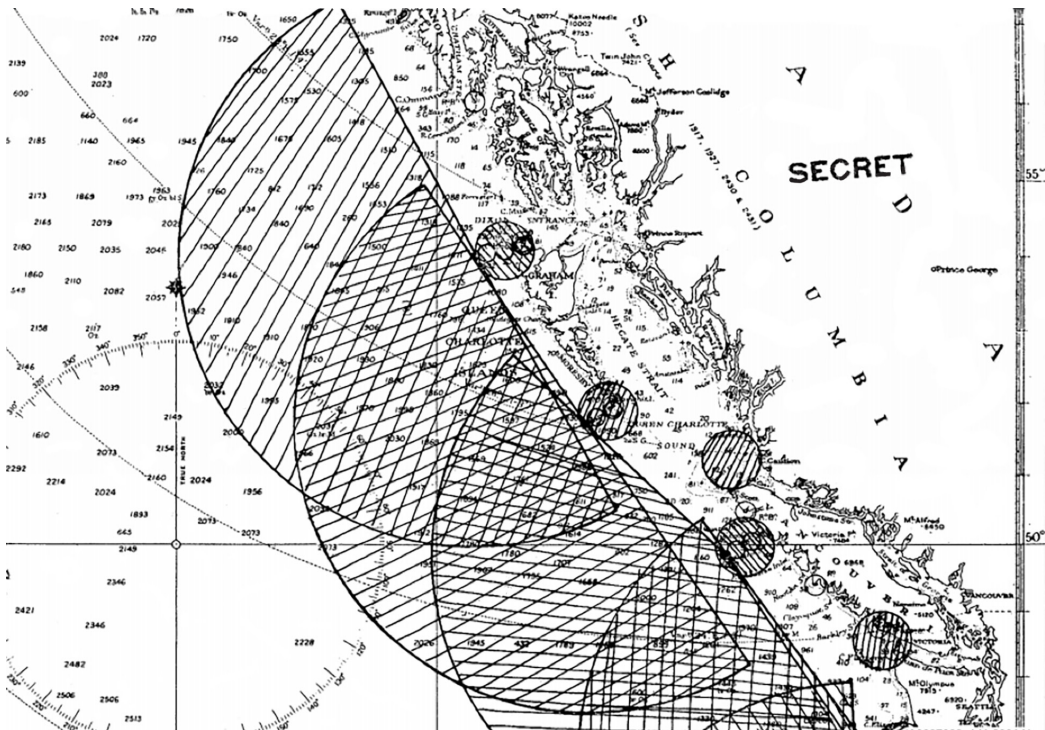
the number of CORSAIR stations required, but the accompanying charts gave a theoretical projection of as many as fifteen arrays on the east coast and five on the west. These would monitor the approaches to the Strait of Belle Isle, the Strait of Canso, and the Bay of Fundy on the Atlantic coast, and Dixon Entrance, Queen Charlotte Sound, and the Strait of Juan de Fuca on the Pacific.³⁷

Although the planners went "all in" on sound surveillance, they did not neglect the need for other detection technologies. In particular, since they presumed that Soviet submarine commanders would have to communicate with their headquarters before launching a missile attack, reliable direction-finding and electronic countermeasures (ECM) capabilities would be essential. Nonetheless, the LOFAR/CORSAIR combination would constitute the primary trip wire, and it promised to "provide the necessary warning to cover the seaward approaches to our coastal areas."³⁸

FORCE REQUIREMENTS

The *Seaward Defence Report* considered in great detail the nature of forces required to intercept SSGs using the information provided by sound surveillance. The situation confronting the planners was unprecedented; although the RCN had plenty of experience hunting submarines off the Atlantic coast in both world wars, never before had it faced a threat as grave as the missile-firing submarine.

MAP 2 PROPOSED WEST COAST SOUND-SURVEILLANCE SYSTEM



Source: CNS, "Underwater Surveillance Requirements."

Consequently, the report's authors understood that to avoid a catastrophic nuclear scenario, A/S forces required the capability to prosecute any contact swiftly. This placed a reliance on "offensive support" to the sound-surveillance system. The report explained it this way: The nature of the threat, coupled with the long-range detection capability of LOFAR, defined the characteristics required in offensive supporting units. These were as follows:

- (i) Ability to locate the submarine as near as possible to the point of first detection
- (ii) Ability to attack and destroy the submarine, with the smallest possible time delay, by day or night, in any weather
- (iii) Ability to patrol continuously the outer limits of the detection arc³⁹

Mobility was key, requiring forces to have the ability "to locate, hold, attack, and destroy the submarine"—quickly. The RCAF's MPAs would form the backbone of the system, and they would require "all weather and long endurance qualities."⁴⁰ Here, Canada was in good shape. The majority of the RCAF's maritime-patrol squadrons were equipped with the Lockheed P2V-7 Neptune, which the report suggested "would provide the best type for the roles envisaged."⁴¹ But the

Neptunes were only a temporary stand-in until the VLR Canadair CL-28 Argus, arguably the most effective MPA of its generation, entered service in 1957. When the Arguses became operational, naval CS2F Trackers would supplement the RCAF effort by flying inshore patrols from shore bases or the carrier.⁴²

Despite its substantial capability, the air umbrella required seagoing support. The Second World War experience had shown that aircrews found it nearly impossible to confirm the results of attacks on submerged submarines, and the report concluded that since “the final destruction of the [missile-firing] submarine must be assured, in this task both aircraft and ships are required.” The authors determined that the ship designated for seaward defense “must be capable of high speed (say 30 knots), it must have long endurance at medium speeds, and it must be designed primarily to operate effectively under North Atlantic weather conditions.” Other desired features included superior sea-keeping qualities; the ability to operate sonar at high tactical speed; gun armament capable of destroying submarines and providing anti-aircraft defense; effective A/S weaponry; radar and communications systems able to control helicopters and provide long-range air warning; and, because of the expected long duration of patrols, a high level of comfort and habitability.⁴³

The Second World War-era destroyers that then formed the most potent element of the RCN’s A/S force had the speed and punch required, but lacked endurance. The River-class frigates, *Bangor*- and *Algerine*-class minesweepers, and Bird-class patrol boats that formed the remainder of the force were deemed wholly inadequate. The report’s authors thought the RCN had the solution in hand in the form of the new escorts about to join the fleet: “The destroyer of *St. Laurent* type with speed, sea-keeping qualities, if provided with an adequate gun armament, would most nearly meet the envisaged operational requirement.”⁴⁴

How would this combination of air and surface forces, cued by sound surveillance, locate and destroy missile boats? At the time it was thought that, to launch its missiles, a submarine would have to surface for little more than three minutes; however, the estimated duration grew over time.⁴⁵ Given current assessments of battery capacity, it was estimated that a submerged submarine would be able to penetrate about 175 miles into the three-hundred-mile LOFAR detection zone before it had to expose itself to detection from sound surveillance by snorkeling. From that point, “a submarine would be required to transit the remaining 55 miles to an optimal firing position at snorkeling depth or on the surface. At a snorting speed of 10 knots, time of transit would be approximately 5½ hours.”⁴⁶

Owing to the probability that submarines would be vulnerable only once they were well within the detection zone, a “perimeter type patrol” was deemed unsuitable; instead surface forces should be positioned within the LOFAR zone. Patrol areas for fixed-wing aircraft could be more variable and reserve aircraft

could be held in readiness at their airfields. In terms of numbers, it was thought that a "four ship support force for each LOFAR installation provides an efficient unit," which meant a force of twenty-four dedicated surface vessels on the east coast and twelve on the west coast, for a total of thirty-six *St. Laurents*. For fixed-wing aircraft, the minimum number required for the east coast was calculated to be six on patrol and six at readiness, with half those numbers in the Pacific. These numbers increased dramatically when maintenance and training requirements were taken into account.⁴⁷

Although mainly concerned with countering missile boats, the *Seaward Defence Report* touched on tangential aspects of navy policy and operations. Perhaps most importantly, although it did not question sacrosanct SACLANT plans, the threat from missile boats raised the possibility that Canada might have to reconsider sending the bulk of its A/S forces overseas to EASTLANT at the outset of any conflict. The report also considered the implications of the U.S. Navy / Air Force Lamplight study into requirements for the continental air defense of North America. The report noted that some of the warning systems the American study recommended would complement the seaward-defense plan, and suggested that RCN escorts could contribute as air-defense picket ships, "both by providing information to the system and by acting offensively on the information provided by it." This meant the ships would require sophisticated air-defense capability.⁴⁸

Communications, command-and-control organization, base requirements, and other vital factors also received consideration. In terms of sustaining seagoing forces, the RCN possessed only limited underway-replenishment capability and no fast oilers; however, the committee thought this unnecessary for warships operating in the LOFAR zone—which would seem to fly in the face of its stated requirement for the ships to have long endurance.⁴⁹ On the other hand, the committee recognized that A/S helicopters could play a critical role, either attacking contacts located closer inshore or operating from a dedicated carrier.⁵⁰

Mine clearance received considerable attention. Recent experience in the Korean War and ongoing intelligence emphasized the Soviets' strong commitment to mine warfare and their use of moored, ground, and drifting mines with varied firing mechanisms, including contact and influence (magnetic, acoustic, and pressure), combined with various delayed fuses. In view of this threat, the committee recommended that the "main ports" of Halifax, Sydney, and Esquimalt/Victoria be kept open at all times, with forces available to clear "lesser ports" within forty-eight hours.⁵¹

In terms of the traditional static components of seaward defense, the report questioned whether there was any further need for coastal-artillery batteries and suggested that net defenses could be reduced. The authors thought that

controlled minefields and indicator loops still had utility, but the need for them could be reconsidered once the sound-surveillance system was developed.⁵² In terms of coastal convoys, the report suggested they would not be required on Canada's west coast but "will be required on the East Coast unless long range detection devices with adequate supporting forces can be developed."⁵³ In many areas, therefore, the potential of the new sound-surveillance system promised a transformation in seaward defense.

THE SHORTCOMINGS

Notwithstanding the presentation of a realistic concept to counter missile-firing submarines, the *Seaward Defence Report* suffered a number of shortcomings. Some of these can be attributed to patchy intelligence or a lack of concrete information about the actual capability of sound-surveillance systems, but others stemmed from oversights or flawed thinking. In his cover letter, the Chief of the Naval Staff (CNS), Vice Admiral E. Rollo Mainguy, explained that the report took no account of the costs or personnel implications associated with the concept.⁵⁴ Despite this, the authors stated some specific requirements, such as additional surveillance arrays, and the precise numbers needed to bring air and seagoing forces up to the proposed strength. Naval leaders also used the report's findings as a rationale for procuring additional *St. Laurents*. Consequently, the lines were blurred on whether the plan was a conceptual think piece or a road map to a specific objective.

Certain operational factors also were not taken into account. There was no statement regarding when the forces providing offensive support to the sound-surveillance system would be deployed. Would they be on constant patrol as a deterrent, or deploy only in an emergency? That, of course, would affect the numbers of ships and aircraft required, but also would depend on Soviet capabilities. Would the Soviets mount standing patrols in peacetime or only surge into missile-firing positions just before or at the outbreak of any conflict, thus likely providing a degree of warning? As mentioned previously, the report also surprisingly made no mention of the possibility of the Soviets adopting nuclear propulsion; if they could mate nuclear warheads with missiles, surely they could do the same with nuclear propulsion and submarines. By ignoring such issues, the report lost an element of rationality. As will be seen, senior defense officials did take these factors, and others, into account.

There was subtext to the *Seaward Defence Report*, which may help to explain its deficiencies. Since its establishment in 1910, the RCN had struggled to thrive in the face of government and public indifference. With budgets tightening with the end of the Korean conflict, the report offered an opportunity to allay the impact of cuts on the navy. Continental air defense was a primary reason the

RCAF captured a major portion of the defense budget. By inserting a maritime component into the continental-air-defense equation in the form of the missile-firing submarine, naval leaders hoped to obtain a greater share of the financial pot. In his cover letter to the report, Admiral Mainguy emphasized that vital targets within the range of SSGs "may be in just as much danger from thermo-nuclear attack delivered by submarine as from the same attack delivered by aircraft."⁵⁵ Surely, when the specter of nuclear war lay at the forefront of defense considerations and was very much in the public eye, the government could not ignore the threat of nuclear attack from the sea? Naval leaders clearly hoped that their seaward-defense concept would enable them to take advantage of a real and substantial national concern and affirm the navy's increased relevance to continental defense. It also presented an opportunity to upgrade the fleet. Although the recently approved *Vancouver*-class frigate program promised to deliver a useful oceangoing escort, the senior staff had become concerned by its limited performance and lack of general-purpose capability. The *Seaward Defence Report* made the case for replacing the *Vancouver*s with additional *St. Laurents*, which would strengthen the fleet.

Although the report's authors did not express these ambitions directly, they clearly were in play. Given the chronic uncertainty that had shrouded much of the RCN's history, it is hard to blame the authors for playing these cards.⁵⁶

THE U.S. NAVY'S APPROACH

The U.S. Navy also grappled with the SSG threat. An attack-at-source approach by carrier strike forces against Soviet submarine bases and the use of HUKs on barrier patrols were key elements of its existing ASW plans; however, like the RCN, the U.S. Navy envisioned sound-surveillance systems as "the most promising solution" to SSGs. As a December 1954 report to the Chief of Naval Operations (CNO) from the Anti-Submarine Plans and Policies Group explained, HUKs "were not created to search wide areas of ocean in the hopes of discovering an enemy submarine." "It is our earnest hope," the report continued, "that the LOFAR stations which form our Sound Surveillance System in the Atlantic and Pacific will furnish us with the necessary operational intelligence and will give us the advance warning that we need to meet the threat of a mass nuclear guided missile attack launched from submarines."⁵⁷

The report referenced exercises using MPA/destroyer teams to chase down contacts detected by sound surveillance, while carrier HUK groups patrolled beyond the range of the detection system farther out to sea.⁵⁸ Although it is not known whether the two allies consulted one another at this early stage of the SSG problem—it seems likely that they did, given the cooperation over Station Fox and other matters—the concept showed that USN thinking paralleled that of the

RCN; the main difference was that the RCN was prepared to position its carrier group inside the LOFAR detection zone. Beyond this overall tactical harmony, the United States, like Canada, was shifting more of its A/S focus from overseas to home waters in response to the SSG threat; in October 1955, a senior Canadian official reported that the U.S. Navy had reassigned forty-four destroyers and destroyer escorts from EASTLANT (headquartered near London, England) and IBERLANT (Lisbon, Portugal) to WESTLANT (Norfolk, Virginia).⁵⁹

The fact that the U.S. Navy had dozens of escorts to shuttle among theaters underscores the greatest difference between the two navies: although the RCN could match its ally in terms of quality, it paled with regard to quantity. The U.S. Navy simply had the ability, and willingness, to devote more resources to the SSG problem. For example, in the summer of 1956 the U.S. Navy's Project Nobska study emphasized the potential of nuclear-powered submarines (SSNs) for ASW.⁶⁰ SSNs evolved into arguably the most effective A/S platform; however, while the RCN pushed hard to acquire them in the late 1950s, the Canadian government considered them beyond its means. In another example, in 1959 the U.S. Navy formed Task Group (TG) Alfa to evaluate new A/S concepts. Consisting of an A/S carrier, a destroyer squadron, A/S submarines, a shore-based MPA squadron, and abundant research support, Alfa rivaled the capability of the RCN's entire Atlantic fleet.⁶¹ The resources the U.S. Navy could apply were unmatched—and in anti-SSG warfare, numbers mattered.

DENUNCIATION

The *Seaward Defence Report* received mixed reviews when it was evaluated by senior naval and departmental leadership. Since most of the senior RCN leadership had been involved with the study, it is not surprising that the navy gave it close-to-universal acceptance. The only debate revolved around the recommended cancelation of the *Vancouver*-class frigates, a program for which the navy had fought long and hard; however, the argument for more *St. Laurents* eventually won out.⁶²

From there the plan encountered rough seas. When RCN leaders presented the *Seaward Defence Report* to senior defense officials in the autumn of 1955, they asked for an additional twenty-five *St. Laurents* on top of the fourteen already approved, as well as funding for surveys for a sound-surveillance system. The Chiefs of Staff Committee and senior defense officials agreed to the cancelation of the *Vancouver*s and endorsed a limited survey plan, but they balked at the numbers of additional *St. Laurents*; in a tortuous five-year process, the government ultimately approved only an additional six of the class.⁶³

And that was as good as it got; other elements of the report's findings encountered heavy criticism from those who had to grant final approval. At an

October 1955 Chiefs of Staff meeting, Lieutenant General Charles H. Foulkes and Deputy Minister of National Defence Frank R. Miller, the senior military and departmental leaders, respectively, questioned the assumptions on which the naval staff had based its planning, particularly on the likely course of nuclear war. They thought it "improbable" that the Soviets would deploy missile submarines to North American waters in advance of any conflict, because of the danger of provocation, and they noted the uncertainty within NATO about how a nuclear war actually might unfold. They also were dismayed by the lavish recommendations for additional ships and aircraft, believing the plans were based on numbers and not actual need. As Deputy Minister Miller put it, "What was required was a force to do the job rather than a specific number of ships," with the navy using "effectiveness as a yardstick rather than numbers when considering the building programme"; since the new ships were vastly more capable than the old, should the navy not be able to get by with fewer of them?⁶⁴

The air force was more critical. The RCAF consistently had questioned the need for naval aviation in the Canadian context, so it was not surprising that the chief of the air staff, Air Marshal C. Roy Slemon, opposed the navy's plans.⁶⁵ He complained that the RCAF had not been consulted, and insisted that aircraft alone could support the sound-surveillance systems, negating any need for additional ships. Slemon also noted that, according to his information, the Soviets would not possess seagoing nuclear-missile technology for another five years—which, of course, was precisely the window on which the RCN had focused.⁶⁶

These criticisms crippled the navy's plans, and the final nail in the coffin was hammered home a few weeks later when the naval staff sought additional funds to fulfill some of the measures recommended by the *Seaward Defence Report*. The members of the powerful departmental finance committee were unmoved by the navy's arguments and rejected a budget increase to cover the cost of additional *St. Laurents* or to fulfill any other measures associated with the plan. Although senior defense officials acknowledged that they were taking a risk in the face of the SSG threat, the navy's plan simply was beyond what the government was willing to devote to maritime defense.⁶⁷

OPERATIONAL TRIALS

If the acquisition and budgetary aspects of the *Seaward Defence Report* largely went unachieved, its operational concepts proved enduring. In early 1956, NSHQ formed the Naval Warfare Study Group to investigate further how the RCN would fight a war at sea under the agreed NATO strategy, designated M.C. 48. The new group's core, including Commodore Raymond and Captain Landymore, had been influential contributors to the Seaward Defence Committee.⁶⁸ Foremost among the new group's aims was determining how to defend against the

“Principal Threat: Attacks on inland and Coastal targets by submarine-launched guided missiles with nuclear warheads.” One decision, obviously based on the deliberations of the Seaward Defence Committee, was to divide the seaward-defense area into three zones: “an inner firing zone (where submarines might fire [missiles] upon shore targets, a middle combat zone (where submarines might be destroyed), and an outer harassing zone (where submarines could be prevented from snorkeling).”⁶⁹ The distance of the zones from the coast would vary according to conditions, but the idea was to force submarines to snorkel well before they reached launching positions, to be detected by the sound-surveillance system, which would cue offensive forces onto the contact.

The RCN tested these concepts in a series of exercises called BEAVERDAM. More than anything, the exercises revealed the near impossibility of destroying missile boats before they launched their payloads. BEAVERDAM 3, carried out off Nova Scotia in March 1959, provided stark evidence of the challenges confronting A/S forces.

The exercise executed the so-called BEARTRAP plan, which anticipated an emergency situation in which missile attacks from submarines were “imminent.” For this scenario, the plan assumed the SSGs had penetrated the sound-surveillance net to reach their firing positions, with the objective of reducing Allied “retaliation capacity” by attacking SAC bases, with ports and population centers secondary targets. “Hostilities are assumed to commence,” the exercise orders explained, “with the first firm knowledge that a missile has been launched or with the discovery of a fully surfaced submarine in a position from which the Primary and Secondary targets could be effectively attacked.” Until those conditions prevailed, “submerged or snorting intruders can only be tracked and heckled—no live-load weapon attacks could be pressed home by anti-submarine forces.”⁷⁰ By this time it was thought that boats would have to surface for ten minutes to launch their missiles, and BEARTRAP called for “the concentration of surface and air forces within what are deemed probable missile launching areas, in such density as to ensure that a submarine can be observed and attacked within ten minutes of surfacing. This, of course, necessitates some calculated risks because of limitations imposed by the forces which are expected to be available. Equal intensity coverage could not be planned throughout the entire CANLANT area.” For BEAVERDAM III, the exercise was confined to an area amounting to one-third of the full CANLANT zone, with participating air and surface assets limited by the same proportion. Three submarines formed Orange, while Blue comprised the aircraft carrier *Bonaventure*, nine escorts, three maritime-patrol squadrons, and Station Fox.⁷¹

BEAVERDAM III tested counter-SSG tactics in the so-called inner firing zone, and the positioning of the Blue forces reflected the *Seaward Defence Report’s*

concept of an immediate offensive response. In line with how it was thought the Soviets would mount such an operation, the three Orange submarines, HMS *Alderney* and *Ambush* and USS *Redfin*, targeted specific U.S. air bases: *Redfin* was to hit Loring Air Force Base (AFB) in northeast Maine; *Ambush* was assigned Ernest Harmon AFB at Stephenville, Newfoundland; and *Alderney* targeted Argentia Naval Air Station on Newfoundland's south coast.⁷² It was thought that SSGs would have to approach to within visibility range of a geographic feature such as a headland to fix their position to input accurate navigational guidance for their missiles; accordingly, Blue surface groups were deployed on either "fixing point patrols" off obvious landmarks or "surface force patrols" in high-probability launch areas farther out to sea. Blue-force MPAs saturated the same areas. *Bonaventure*, with CS2F Trackers embarked, was positioned to seaward of the MPA patrols; the carrier was escorted by only a single plane-guard destroyer, since planners assumed an SSG would avoid attacking such a target before hostilities broke out.⁷³

The main aim of BEAVERDAM III was to determine whether an MPA orbiting within ten minutes' flight time of a surfaced SSG could detect and attack it before it launched its missiles. The postexercise analysis declared that "a measure of success was achieved"; however, that measure was small indeed. Of the eighteen opportunities MPAs had to detect surfaced submarines during the three phases of the exercise, two boats were detected within two minutes and killed, another was killed during the ten-minute launch window, another kill occurred just after launch, and in two instances air patrols prevented boats from surfacing. Thus, only three launches definitely were thwarted—which meant that as many as fifteen nuclear-armed missiles rocketed toward their targets.⁷⁴

The performance of the surface groups was even more dismal. Most ships failed to approach within a dozen miles of a submarine, and in the one close encounter, although *Ambush* sighted the new destroyer *Restigouche* through its periscope when passing within 2,800 yards, the ship's sonar failed to detect the SSG. Two summaries give a flavor of the encounters. At 0950 on 12 March:

Alderney surfaced in position 44-44N 59-36W, and at 1000 simulated firing her first missile at Argentia. Assessed as a successful missile launch. This launch was made 22 miles from the center of Area 2, in the close proximity of a fleet of approximately 30 fishing vessels. The area was being surveyed by Summerside Neptune Y4X04. At 1025, *Alderney* surfaced in the same position and at 1035 simulated firing her second missile at St. John's, NFLD. Assessed as a successful missile launch.

At about the same time:

Ambush surfaced in position 43-45N 59-36W, and at 1003 simulated firing her first missile at Stephenville. Assessed successful missile launch. This launch was made 7

miles from the center of Area 3 which was being surveyed by *Bonaventure* Tracker 34 Dressing Room. *Ambush* dived and surfaced again at 1018 to prepare her second missile for launch at 1031. She sighted *Bonaventure* Tracker 34 Dressing Room closing 90 seconds before scheduled launch time; however, *Ambush* remained on the surface, altered end-on to the aircraft, and simulated firing on schedule, again at Stephenville. She dived immediately on firing and was attacked with depth charges 30 seconds after submerging. 34 Dressing Room attack assessed possible kill.⁷⁵

The exercise analysis found numerous reasons why the SSGs carried out their missions virtually unscathed. The notoriously poor ocean environment off Nova Scotia hindered the performance of sonar; the dozens of fishing vessels in the area clogged radar screens and provided cover for submarines; aircraft failed to use ECM; and communication between ships and aircraft was poor or nonexistent. Interestingly, although it was thought that poor weather would hamper not only the MPAs but the SSGs as well, the submarines still were able to fix their launch positions from features ashore. “Consequently, even though adverse conditions appear to create a stalemate, any reliance upon unfavorable circumstances to discourage missile attacks, would be wishful thinking.”⁷⁶

The grim results of BEAVERDAM III were mirrored in other exercises in the series. This suggested that any optimism about defeating SSGs was itself “wishful thinking.”

TO THE FUTURE

Appearing before Congress in 1958, American naval leaders warned of the gravity of the SSG threat. Rear Admiral Hyman G. Rickover, Assistant Chief for Nuclear Propulsion at the Bureau of Ships, testified as follows:

We know [the Soviets] have operational missiles which are good for at least 200 miles and probably more. I would anticipate that in the not too distant future they will have operational missiles with a range of up to 600 to 700 miles. Therefore, with a large number of submarines that can carry missiles fitted with atomic or hydrogen warheads, they have the capacity to operate off our coasts and destroy our cities. . . . [This] is the gravest immediate threat that faces the United States.⁷⁷

The threat was indeed ominous, but a lot of flesh had been put on the bones of solutions to the SSG problem since the RCN had produced the *Seaward Defence Report* three years earlier. Intelligence had a firmer grasp of Soviet strategy and capability; sound-surveillance systems maintained their abundant promise; tactics had matured, through exercises such as BEAVERDAM III; and new and evolving countermeasures—such as A/S submarines, the *Jezebel* passive acoustic processor, magnetic anomaly detection, Julie explosive echo ranging, and nuclear depth charges—had increased the probability of killing missile boats. Canadian maritime forces and the U.S. Navy also arrived at a unified strategy to deal with

the SSG problem.⁷⁸ Against that, the Soviets were ready to deploy their first wave of SSGs with more-advanced missiles, and had developed another potentially devastating weapon in the nuclear torpedo.⁷⁹

Yet despite the relentless march of measure and countermeasure, the basic contentions introduced in the *Seaward Defence Report* remained valid. Any hope of intercepting SSGs before they launched their missiles required a reliable, long-range means of detecting them and the ability to respond quickly and decisively to the information.

When the Cold War threatened to explode during the tense weeks of October–November 1962's Cuban missile crisis, Canadian maritime forces used the concepts of the *Seaward Defence Report* to defend the eastern seaboard of North America. MPAs saturated potential submarine launch positions, while surface groups were positioned to provide offensive support to the sound-surveillance arrays at Shelburne and Argentia; later in the crisis Canadian sea- and airborne forces moved south to help defend U.S. assets.⁸⁰ Although it is unknown whether the Soviets deployed SSGs or other boats into the Canadian northwest Atlantic during the crisis (current research suggests they did not), if they did so Canadian maritime forces, by implementing the concepts of the *Seaward Defence Report* and working seamlessly with their USN allies, were at least well positioned to intercept them; whether they could have destroyed them before the critical moment of missile launch is another question.⁸¹

Nonetheless, using the information at their disposal at the dawn of the SSG threat, the authors of the RCN "new look" delivered a sound, innovative defensive concept. And that concept proved adaptable and enduring.

The process of formulating a seaward-defense plan in the shadow of an emerging nuclear threat, as well as the operational concept at which naval planners arrived, has utility beyond the scope of this article. In terms of the planning process, three avenues for further analysis present themselves.

First, what does the RCN and USN response to the SSG threat say about the two services' ability to handle dynamic strategic and tactical circumstances? In particular, the U.S. Navy has served as a useful model of how such institutions deal with change; and, depending on the availability of historic documentation, an examination of its organizational response to the ASW challenges confronting it in the 1950s could be instructive in this regard.⁸²

Second, the stark contrast between the resources the two navies could apply to the SSG problem would make for useful analysis into how organizations with varying levels of fiscal, political, and public support cope with such dynamic change. Small- and medium-size navies such as the RCN simply cannot adjust to such circumstances in the same way the U.S. Navy can. Given that the U.S. Navy

has striven to enhance relationships with allies—to build what one CNO referred to as a “thousand-ship navy”—comparative analysis of how such relationships might be affected by the inability of other navies to meet change at the same pace as their American ally—which could result in a critical “capability gap”—would seem germane.⁸³

Finally, the measures of the seaward defense plan and the application of the forces potentially involved invite study in terms of their viability in the face of some of the challenges facing today’s naval planners. For instance, since aspects of the plan can be applied to the notion of antiaccess warfare, it can be used to weigh both defensive and offensive perspectives of the concept.⁸⁴

In the end, it is probably best that we do not know whether the seaward defense plan, or any similar plan, would have been successful if tested by actual nuclear attack. Nonetheless, studying the plan has value in both the historical and contemporary contexts.

NOTES

- This study originated from the author’s research as head of the team preparing the official history of the RCN, 1945–68. He acknowledges previous groundbreaking research by Dr. Isabel Campbell on this period for the RCN official history. Cdre. Jan Drent, RCN (Ret.), and Prof. Sean Maloney of the Royal Military College of Canada commented on this study, and over many years the latter generously has shared his insights into Cold War planning and operations. The author also thanks the three anonymous Naval War College referees who contributed valuable suggestions. Finally, the views expressed in this article are those of the author, not the Canadian Department of National Defence, and he alone is responsible for any errors.
1. Quoted in Owen R. Cote Jr., *The Third Battle: Innovation in the U.S. Navy’s Silent Cold War Struggle with Soviet Submarines*, Newport Paper 16 (Newport, RI: Naval War College Press, 2003), p. 20.
 2. Following USN and RCN practice in the 1950s, the term SSG is used to categorize Soviet conventionally powered submarines capable of launching guided missiles against continental targets. It should not be confused with the later designation for cruise-missile submarines targeting seagoing task forces.
 3. PAUKENSCHLAG (DRUMBEAT) was the name given the German U-boat offensive off the east coast of North America that began in January 1942. For more on Operation PAUKENSCHLAG, see Michael Gannon, *Operation DRUMBEAT: The Dramatic True Story of Germany’s First U-boat Attacks along the American Coast in World War II* (New York: Harper and Row, 1990).
 4. Capt. F. W. T. Lucas to Chairman, Chiefs of Staff Committee, 5 September 1955, in *Report of the Seaward Defence Committee*, April 1995, vol. 21471, file CSC 2110, vol. 1, Record Group [RG] 24, Library and Archives Canada, Ottawa, Canada [hereafter LAC] [hereafter *Seaward Defence Report*]. Lucas was secretary to the Chiefs of Staff Committee; his reference to a “new look” mirrored what Jeff Barlow describes as the “catchy” title of President Eisenhower’s New Look defense policy. Jeffrey G. Barlow, *From Hot War to Cold: The U.S. Navy and National Security Affairs, 1945–1955* (Stanford, CA: Stanford Univ. Press, 2009), pp. 378–79.
 5. Quoted in Nicholas Tracy, *A Two-Edged Sword: The Navy as an Instrument of Canadian Foreign Policy* (Montreal: McGill-Queens Univ. Press, 2012), p. 102.

6. Isabel Campbell, "Canadian Insights into NATO Maritime Strategy, 1949–70: The Role of National and Service Interests," *Northern Mariner* 25, no. 3 (July 2015), p. 241; Sean M. Maloney, "Parry and Thrust: Canadian Maritime Forces and the Defence of North America, 1954–62," *Northern Mariner* 18, no. 1 (January 2008), p. 40. These studies are available online at www.cnrs-scrn.org/. A good starting point into the history of the Canadian military during the Cold War remains Sean M. Maloney, *Learning to Love the Bomb: Canada's Nuclear Weapons during the Cold War* (Washington, DC: Potomac Books, 2007), while Sean M. Maloney, *Securing Command of the Sea: NATO Naval Planning 1948–1954* (Annapolis, MD: Naval Institute Press, 1995) covers the establishment of SACLANT.
7. RCN policy in the immediate postwar years is covered in Jan Drent, "'A Good, Workable Little Fleet': Canadian Naval Policy, 1945–1950," in *A Nation's Navy: In Quest of Canadian Naval Identity*, ed. Michael L. Hadley, Rob Huebert, and Fred W. Crickard (Montreal: McGill-Queen's Univ. Press, 1992), pp. 205–20.
8. For the postwar modernization of British escorts, see Norman Friedman, *British Destroyers & Frigates: The Second World War and After* (Annapolis, MD: Naval Institute Press, 2017), and David K. Brown and George Moore, *Rebuilding the Royal Navy: Warship Design since 1945* (Annapolis, MD: Naval Institute Press, 2003). The Type 15 and 16 conversions were similar to the USN Fleet Rehabilitation and Modernization (i.e., FRAM) program.
9. For the poor outcome of a 1956 A/S exercise, see Michael Whitby, "Views from a Different Side of the Jetty: Commodore A. B. F. Fraser-Harris and the Royal Canadian Navy, 1946–1964," *Northern Mariner* 22, no. 1 (January 2012), pp. 11–13, available at www.cnrs-scrn.org/.
10. The CS2F was identical to the USN Grumman S2F but built under license in Canada.
11. This discussion is based on the author's ongoing research for the official history of the RCN 1945–68.
12. See Campbell, "Canadian Insights into NATO Maritime Strategy," pp. 245–53.
13. "Terms of Reference," in *Seaward Defence Report*.
14. The working group was chaired by the DNPO, with members as follows: Director, Naval Aviation, Capt. A. B. Fraser-Harris; Director, Naval Communications, Capt. R. W. Murdoch; Director, ASW, Cdr. P. S. Booth; and Director, Navigation and Direction, Lt. Cdr. P. G. Chance.
15. "Security Caution" on *Seaward Defence Report*, 15 April 1955. This summary for the Chiefs of Staff Committee explained that the study "is based in large part on the capability of underwater sound surveillance systems which have not yet been released to NATO and which are being developed on an informational exchange basis between Canada, the UK, and the US." See Joint Planning Committee to the Chiefs of Staff Committee, 7 October 1955, in *Seaward Defence Report*.
16. Secretary to COS, "Seaward Defence," 17 October 1955, in *Seaward Defence Report*.
17. "Assessment of the Threat and Tasks Arising Therefrom," paper 2 in *Seaward Defence Report*.
18. When the North American Air Defense Agreement came into effect in September 1957, the RCN's two fighter squadrons were assigned a specific continental-defense role. *Seaward Defence Report*.
19. "Assessment of the Threat and Tasks Arising Therefrom."
20. "Nuclear Weapons," annex 1 in *Seaward Defence Report*, app. D. To be more accurate, it was thought the Soviets might position a submarine inshore of an SSG to take over guidance of missiles launched from farther out.
21. *Nautilus's* commanding officer transmitted the famous message "Underway on nuclear power" on 17 January 1955.
22. Emphasis in original.
23. "Nuclear Weapons."
24. Describing the Soviet SSG threat, on 18 June 1953, Vice Adm. R. F. Good, Deputy CNO (Logistics), testified to Congress, "We know they have the submarines, Sir; we know they have exploded an atomic bomb. Whether they do in fact have the capability of delivering the bomb from a submarine, I do not

- personally know, sir. . . . Given the bomb and the submarine, I think it is quite probable they would put the two together.” Cited in U.S. Navy Dept., *Sea-Based Airborne Antisubmarine Warfare 1940–1977*, vol. 1, 1940–1960 (Washington, DC: Office of Naval Research, February 1978), app. 3, pp. 66–67. This important study was prepared under contract by R. F. Cross Associates.
25. The term *flaming datum* refers to the fact that when a submarine attacks a ship (and sets it afire) it at least momentarily provides a good indication of its own position.
 26. For a contemporary study of the utility of HUK operations, see A. L. Danis [Lt., USN], “Offensive ASW: Fundamental to Defense,” U.S. Naval Institute *Proceedings* 83/6/652 (June 1957), pp. 583–89. As far as can be ascertained, none of the officers on the Seaward Defence Committee were cleared for ULTRA during the war, so the members were unaware of its role.
 27. CNS, “Underwater Surveillance Requirements,” 14 September 1955, p. 2, vol. 1471, file CSC 2110, vol. 1, RG 24, LAC.
 28. Chiefs of Staff Committee minutes, 1 April 1954, 73/1223, file 1307B, Directorate of History and Heritage, Ottawa, Canada [hereafter DHH]. For a short, sanitized history of the Canadian navy’s role in sound surveillance, see Rodney R. Bickford [Lt., RCN], “Canadian Undersea Surveillance,” U.S. Naval Institute *Proceedings* 121/3/1,105 (March 1995), pp. 70–71.
 29. Chiefs of Staff Committee minutes, 1 April 1954.
 30. LOFAR later was known as SOSUS, for *sound-surveillance system*. Friedman describes the term LOFAR as “a made-up word, intended to sound like RADAR and SONAR.” See Norman Friedman, *Network-centric Warfare: How Navies Learned to Fight Smarter through Three World Wars* (Annapolis, MD: Naval Institute Press, 2009), p. 160.
 31. U.S. Navy Dept., 1940–1960, pp. 132–33, 153. See also Norman Polmar and Edward Whitman, *Hunters and Killers*, vol. 2, *Anti-submarine Warfare from 1943* (Annapolis, MD: Naval Institute Press, 2016), pp. 121–26; Friedman, *Network-centric Warfare*, pp. 159–61; Christopher Ford and David Rosenberg, *The Admirals’ Advantage: U.S. Navy Operational Intelligence in World War II and the Cold War* (Annapolis, MD: Naval Institute Press, 2005), pp. 36–38; and Gary E. Weir, *An Ocean in Common: American Naval Officers, Scientists, and the Ocean Environment* (College Station: Texas A&M Univ. Press, 2001).
 32. “The Use of Sound Surveillance Systems in the Defense of Canadian Coastal Waters,” paper 3 in *Seaward Defence Report*. For CORSAIR, see “Project CORSAIR: Involvement of ARL Stations in Cornwall, Northern Ireland and Shetland Isles,” *History of the Admiralty Research Laboratory (ARL) Teddington: 1921–1977*, arl.g3w1.com/.
 33. *Snorting* was informal naval terminology for *snorkeling*.
 34. “The Use of Sound Surveillance Systems”; “Long Range Underwater Detection Devices,” annex 4 in *Seaward Defence Report*, app. B; CNS, “Underwater Surveillance Requirements.”
 35. “The Use of Sound Surveillance Systems,” pp. 1–2.
 36. “Long Range Underwater Detection Devices,” p. 2.
 37. The RCN did not completely neglect northern waters. Although there was no reference to the Canadian Arctic, a follow-on study indicated that the U.S. Navy and the RN were considering a chain of stations to cover the approaches to the Arctic from the North Atlantic that would stretch from Greenland to Iceland, to the Faeroes and Shetlands, and to Norway. This would cover what became known as the GIUK gap. CNS, “Underwater Surveillance Requirements.”
 38. CNS, cover letter to *Seaward Defence Report*, 7 July 1955; “Offensive Support for Long and Medium Range Detection Devices,” paper 7 in *Seaward Defence Report*.
 39. “Offensive Support for Long and Medium Range Detection Devices.”
 40. Ibid.
 41. “Force and Type Requirements for Fixed Wing Aircraft,” paper 22 in *Seaward Defence Report*.
 42. For details of these aircraft, see Jerry Proc, “The Canadian Neptune P2V7,” “Argus Aircraft—Electronics Fit,” and “CS2F Tracker,” *Radio Communications and Signals Intelligence in the Royal Canadian Navy*, jproc.ca/.

43. "Force and Type Requirements for Coastal Area Surface Ships," paper 21 in *Seaward Defence Report*.
44. Ibid. The main gun armament of *St. Laurent*—and follow-on *Restigouche*-class destroyers was to be a mix of three-inch / .50 caliber and .70 caliber guns. At twenty-eight knots, the design speed of the *St. Laurents* was actually below the desired thirty-knot minimum, but planners thought it could be increased by modifications. They also later proposed acquisition of a Coastal Defense Ship to back up the *St. Laurents*, but the Chiefs of Staff Committee rejected this.
45. "Offensive Support for Long and Medium Range Detection Devices"; "Surface Forces Required for Area Offensive Support (LOFAR)," paper 11 in *Seaward Defence Report*; "Soviet Naval Strength," annex 1 in *Seaward Defence Report*. The calculated time a submarine had to sit on the surface to fire its missiles soon stretched to ten and later fifteen minutes.
46. "Surface Forces Required for Area Offensive Support (LOFAR)."
47. Ibid.; "Fixed Wing Aircraft Force Requirements for Area Offensive Support," paper 12 in *Seaward Defence Report*. These resulted in force projections involving some fantastic numbers, at least for Canada. With regard to fixed-wing aircraft, to meet the desired east coast levels of six aircraft on patrol and six at readiness meant a total of eighty-two midrange P2V-7 Neptunes or sixty-eight long-range CL-28 Arguses. The west coast would need fifty-one CS2F Trackers, thirty-two P2Vs, or twenty-five Arguses. In terms of surface ships, it was determined that sixty-six *St. Laurents* would be required to fill east and west coast demands. NB: Four dedicated surface platforms for each of the five Atlantic coast arrays would total twenty *St. Laurents*, not twenty-four. The sources provide no explanation for this discrepancy.
48. *Seaward Defence Report*.
49. The RCN still had not acquired a replenishment oiler (ship designation AOR) by the time of the 1962 Cuban missile crisis, and it was calculated that the destroyers' need to leave their patrol positions to refuel at shore bases degraded seagoing strength by 25 percent.
50. *Seaward Defence Report*.
51. "Requirements for Minesweeping and Clearance Diving," app. 13 in *ibid*.
52. "Summary of Harbour and Channel Defense Requirements," paper 14 in *Seaward Defence Report*.
53. "The Convoy System in Coastal Waters," paper 6 in *Seaward Defence Report*.
54. CNS, cover letter.
55. Ibid.
56. The RCN had employed similar strategy before, particularly at the 1943 Quebec conference, when the service hoodwinked the Canadian prime minister into agreeing to the acquisition of cruisers and destroyers from the RN in exchange for manning RN landing craft flotillas for Operation NEPTUNE. See W. A. B. Douglas et al., *A Blue Water Navy* (St. Catharines, ON: Vanwell, 2007), pp. 170–74.
57. D. E. MacIntosh [Capt., RCN], Anti-Submarine Plans and Policies Group, 15 December 1954, quoted in U.S. Navy Dept., *1940–1960*, p. 154. The best study of USN ASW strategy remains Cote, *The Third Battle*.
58. MacIntosh, 15 December 1954.
59. DNPO, "Briefing of the Chiefs of Staff Committee, 26 October 1955," 73/1223, 7 November 1955, box 61, file 1308, DHH.
60. For the Nobska study, see Weir, *An Ocean in Common*, pp. 278–83.
61. Thomas D. McGrath [Capt., USN], "Anti-submarine Defense Group Alfa," U.S. Naval Institute *Proceedings* 85/8/678 (August 1959), pp. 49–55; Michael T. Isenberg, *Shield of the Republic: The United States Navy in an Era of Cold War and Violent Peace* (New York: St. Martin's, 1993), vol. 1, pp. 744–47. The RCN worked closely with Alfa, assigning an officer permanently to its staff and contributing equipment and expertise. In return, the RCN received copies of Alfa's reports on the A/S problem. The U.S. Navy later established TGs Bravo and Charlie to investigate other aspects of the ASW problem.
62. Michael Whitby, "Vice-Admiral Harry G. DeWolf: Pragmatic Navalist," in *The Admirals: Canada's Senior Naval Leadership in the Twentieth Century*, ed. Michael Whitby, Richard H. Gimblett, and Peter Haydon (Toronto: Dundurn, 2006), pp. 213–46.

63. These were the four *Mackenzie*- and two *Annapolis*-class destroyer escorts. For the turmoil surrounding the acquisition programs, see *ibid.*
64. DNPO, "Briefing of the Chiefs of Staff Committee, 26 October 1955."
65. For the tortured history of Canadian naval aviation, see Michael Whitby, "Fouled Deck: The Pursuit of an Augmented Aircraft Carrier Capability for the Royal Canadian Navy, 1945–64," *Canadian Air Force Journal* 3, nos. 3/4 (Summer/Autumn 2010), available at publications.gc.ca/.
66. DNPO, "Briefing of the Chiefs of Staff Committee, 26 October 1955." Over the next few years, RCN and RCAF staff worked together to develop a joint plan. In light of Slemon's objections to the initial plan, it is ironic that the final RCN/RCAF version essentially duplicated the navy's original concept.
67. VCNS to CNS, undated, but after 16 November 1955, Naval Board minutes, 81/520/1000-100/2, 22 November 1955, DHH.
68. Naval Board minutes, 1 February 1956, 81/250, DHH. For the origins and deliberations of the Warfare Study Group, see Isabel Campbell, "A Transformation in Thinking: The RCN's Naval Warfare Study Group of 1956," in *People, Policy and Programmes: Proceedings of the 7th Maritime Command (MARCOM) Historical Conference*, ed. Richard H. Gimblett and Richard O. Mayne (Winnipeg: Canadian Naval Heritage Press, 2008), pp. 165–81.
69. Campbell, "A Transformation in Thinking," p. 176.
70. Documentation (see next note) suggests that the U.S. Navy's rules of engagement against unidentified submarines were more aggressive.
71. Maritime Commander Atlantic, "Analysis of BEAVERDAM III (BEARTRAP)," 73/56124, April 1959, pp. 2–3, DHH.
72. The two submarines were British but on loan to the RCN and under Canadian operational control.
73. Maritime Commander Atlantic, "Analysis of BEAVERDAM III (BEARTRAP)."
74. *Ibid.*
75. *Ibid.* Summerside, Prince Edward Island, was the site of the Neptunes' base.
76. *Ibid.*
77. Cited in U.S. Navy Dept., *1940–1960*, app. 3, pp. 75–76.
78. To unify anti-SSG efforts, in 1958 SACLANT created the North American Anti-Submarine Defense Force Atlantic. According to Rear Adm. H. F. Pullen, Canadian Maritime Commander Atlantic, the command was "responsible for the close-in defense of the North American continent against the guided missiles fired from a submarine." Its geographic area of responsibility was not rigidly defined but "extended along the entire eastern seaboard of North America out to the limits of the capability of the weapon he is defending against." H. F. Pullen [Rear Adm., RCN], "Evolution of Control over Naval Forces," n.d., H. F. Pullen Fonds, Manuscript Group 1, vol. 2526, file 3, Public Archives of Nova Scotia, Halifax, Canada. See also Campbell, "Canadian Insights into NATO Maritime Strategy," p. 259.
79. Sean Maloney's research has revealed that in 1958 the commander of SAC warned the U.S. Navy of the threat that radioactive residue from nuclear torpedoes could pose to SAC bases located close to the coast. Sean Maloney, interviews by author, ongoing.
80. After the Cuban missile crisis, Rear Adm. K. L. Dyer, Canadian Maritime Commander, observed, "It appears that SOSUS was not as successful as had been hoped." For more, see Bruce Rule, "Faulty Intelligence Nearly 'Sank' SOSUS during the Cuban Missile Crisis," *IUSS Caesar Alumni Association*, www.iussca.org/.
81. The conclusions about Soviet submarine activity are derived from the author's research into Canada's role in the Cuban missile crisis for the official history of the RCN, 1945–68.
82. See, for example, Gene I. Rochlin, Todd R. La Porte, and Karlene H. Roberts, "The Self-designing High-Reliability Organization: Aircraft Carrier Flight Operations at Sea," *Naval War College Review* 40, no. 4 (Autumn 1987), pp. 76–90.

83. Michael G. Mullen [Adm., USN], quoted in Jason Alexander [Lt., USN], "Don't Forget Our Allies: Interoperable Maritime Operations in a Combined Environment," *Center for International Maritime Security*, 27 March 2019, cimsec.org/.
84. For antiaccess warfare, see Sam J. Tangredi, "Antiaccess Warfare as Strategy: From Campaign Analyses to Assessment of Extrinsic Events," *Naval War College Review* 71, no. 1 (Winter 2018), pp. 33–51, available at digital-commons.usnwc.edu/.