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ANTI-SUBMARINE WARFARE: A STRATEGY PRIMER

by

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This report reviews the naval planner's basic "menu" of operational anti-submarine warfare (ASW) strategical choices. Basic ASW strategies, discussed from a historical perspective, are: (1) destruction of the submarine (2) containment of the submarine, and (3) limiting the submarine's efficiency. The report has been prepared for inclusion in the International Military and Defense Encyclopedia (IMADE), scheduled for publication by Pergamon-Brassey's in 1991-91.				
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Introduction

Anti-submarine warfare (ASW) is probably the most complex form of maritime conflict. The search for solutions of the "submarine menace" tends to be focussed on technological "fixes" - more powerful and longer-range means of surveillance, faster and more accurate detection systems, and stand-off, high-probability-of-kill weapons. Little about the technologies of modern submarine and anti-submarine warfare is comparable with the methods of history's first ASW campaign, World War I. By contrast, ASW strategies have basically remained the same ones that were first tried out more than 70 years ago. It is the purpose of this "primer" to set forth the fundamental choices of ASW strategies that are the framework for the exploitation of ASW technologies.

Anti-Submarine Warfare

Anti-submarine warfare (ASW) is a form of warfare, fought mainly at sea, that is aimed at defeating the war-fighting purposes of the submarine. ASW is practiced at three levels of planning: strategic, operational, and tactical. Basic ASW strategies are of three kinds: (1) destruction of the opponent's submarines (2) containment of enemy submarines, and (3) limitation of the war-fighting efficiency of the hostile submarine fleet. The operational level of ASW planning is concerned with where and how to destroy, contain, or limit the efficiency of hostile submarines. The basic operational choice is whether to defeat the submarine at (1) its sources, i.e. operating bases and construction yards, (2) in the transit areas (the

so-called "chokepoints") that the submarine must pass through to and from its sources, or (3) in the patrol areas themselves. ASW tactics are concerned with the local coordination of platforms, weapons, and sensors in the area of encounter itself. The tactical ASW encounter consists of four phases: (1) surveillance and reconnaissance, (2) detection, (3) tracking, and (4) attack.

Historical Background

ASW emerged as a strategic preoccupation for naval planners during World War I. Pre-war defensive measures against the "submarine torpedo-boat" were little more than ad hoc adaptations of tactical procedures that had been adopted by most fleets to guard against the other "sneak attack" weapon, the torpedoboat. The principal offensive measure relied on the warship's superior speed to run down and ram the underwater opponent; defensive measures included sailing a "zig-zag" course and, in port, the erection of physical obstacles (such as harbor booms and blockships, and anti-torpedo nets), and nighttime illumination.

The pre-1914 failure to anticipate the strategic scope of the submarine problem can be attributed to the dominant "image" of the submarine. First, the submarine was expected to seek out "legitimate," meaning naval targets; few Allied or Entente naval planners on the eve of World War I foresaw that the submarine would be a commerce-raiding weapon first and an anti-fleet weapon second. Furthermore, most naval professionals doubted that the submarine "auxiliary" would be more than a "nuisance;" between its inferior speed, limited combat radius, and near-blindness when submerged, the submarine was expected to limit its wartime contribution to coastal defense and occasional scouting missions on behalf of the "real" fleet of battleships and battlecruisers. Six months into the war, the prognosis of a quick conclusion had collapsed - so had the image of the submarine as an occasional nuisance. At sea, the pre-war

plans for a "decisive battle" gave way to the search for long-term ways and means for defeating the most difficult opponent in recorded Naval history.

ASW Strategies of Destruction

All things equal, the preferred ASW strategy is one that results in the physical destruction of the submarine -- the outcome is permanent and, with the underwater opponent eliminated, resources can be released for other wartime duties. Strategies of destruction have also proven to be the most difficult and risky; depending on the quality and quantity of the opposing submarine force, its complete elimination may take more time and tie up more sources than can be afforded. A different kind of risk may be associated with "strategic" ASW against strategic missile submarines. The destruction (or even the threat of destruction) of this particular type of submarine, claim some commentators, undermines the stability of mutual strategic deterrence, and could force a decision to "use-them-instead-of-lose-them."

Destruction at the Source

The preferred operational strategy of destruction is aimed at the sources of the submarine menace, i.e. operating bases, construction, repair and maintenance yards, and industries that manufacture critical components. The single most important advantage of this approach is that it circumvents ASW's most difficult problem: finding the opponent. Unfortunately from the point of view of the ASW strategist, enemy submarine bases and building yards also tend to be heavily defended and can therefore usually only be attacked at great risk to one's own forces. The allied naval planners of World War I shared President Woodrow Wilson's "despair of hunting for hornets all over the sea when I know where the nest is." But very few among them shared Wilson's willingness to "scarifice half the navy Great Britain and we together have to crush the nest. . . "

The practice and planning of destruction at the source has known four methods: (1) physical seizure and occupation of bases and yards; (2) fleet bombardment, (3) aerial bombardment, and (4) mining. For reasons that are obvious, the first method will be the most decisive one. Yet, for reasons equally obvious, the physical seizure and occupation of enemy submarine bases and yards is likely to be attempted and crowned with success only if they are part of a general campaign of territorial conquest. The Anglo-American and Soviet occupation, in 1944-45, of the French and Baltic coastal areas, respectively, deprived the German U-boat fleet of key operating and construction sources. This outcome was not the result, however, of a deliberate ASW strategy, but instead the "bonus" reward of the Allies' general advance.

Excepting the sporadic shelling, by the Royal Navy, of Germany's U-boat bases on the Belgian coast in World War I, the strategical choice of destroying the submarine menace at its source through fleet bombardment has historically been stymied by the fear of disproportionate losses. Some post-facto commentators have insisted that, had the British Grand Fleet fought the Battle of Jutland (of 1916) to a "decisive" (and presumably victorious) conclusion, Germany's main U-boat concentrations in the Heligoland Bight would have been "sitting ducks." According to Winston Churchill, "It was the policy of Jutland which led directly to the supreme submarine peril of 1917." On balance, however, Churchill's other comment a propos the risks and uncertainties facing the commander-on-the-spot, Sir John Jellicoe, was the weightier one; Jellicoe, he wrote, was "the only man on either side who could lose the war in an afternoon."

The destructive record of mining and aerial bombardment of submarine bases and yards is a mixed one. During World War I a single U-boat was lost among the more than 44,000 mines that were scattered in the Heligoland Bight; altogether 14 U-boats were destroyed in their Baltic Sea training grounds during World War II. Arguably, the most productive result of the Baltic mining offensive

was the interference with crew training and new-construction work-up, i.e. with the U-boats's efficiency. The official British history of The Strategic Air Offensive Against Germany 1939-1945 suggests that the campaign may have prevented 20 Type XXI U-boats from becoming operational.

Especially disappointing were the results of the World War II air offensive against the operational and industrial sources of the U-boat. Principal operational targets were the concrete submarine shelters on the French and Norwegian coasts. Even the heaviest bomb of the war, the 12,500-pounds "Tallboy," failed to penetrate the roofs up to eight meters thick. One U-boat was destroyed at its base in Trondheim, Norway in July 1943. Post-war tests by the Americans indicated that a future air assault against "hardened" submarine pens would probably require nuclear weapons.

Industrial sources for the Allied bombing campaign included four broad target sets: (1) the U-boat building yards themselves (2) centers for the manufacture of key components (e.g., the Hagen center for the construction of batteries) (3) the German industrial and transportation system generally, and (4) the labor force. The British Bombing Survey Unit (BBSU) report on The Effects of Strategic Bombing on the Production of German U-Boats concluded that the bombings directly and indirectly contributed to a production loss of 111 U-boats. It reported that another 42 operational units were destroyed in port. The report acknowledged, however, that the estimated production loss of 30 Type XXIs due to the "indirect" effect of the bombings was, in effect, an "educated guess." Furthermore, most of the U-boat production losses caused by the "direct" effect of bombing occurred in 1945, when no time was left for such boats to become operational.

The reasons for the low profitability of the anti-source bombing campaign were these: (1) the inadequacy (mainly in terms of accuracy) of contemporary bomb-laying techniques (2) the enemy's better-than-expected recovery capabilities (3) the generally

efficient German air defense system, and (4) the "cyclical" pattern of the "direct" offensive against U-boat pens, yards, and other facilities.

Destruction in the Transit and Patrol Areas

Because of the difficulty, in fact, of destroying the submarine at the source, the ASW defender is usually compelled to find ways to defeat it at sea, including the submarine's transit and operational patrol areas.

A key determinant for the success of a strategy of destruction in the transit areas is local geography, i.e. the length, width, and depth of the "chokepoint." The collective ASW benefit of a long, narrow, and shallow area of submarine passage is: (1) a high predictability of the submarine's comings and goings (2) multiple opportunities for attack, and (3) minimum submarine escape volume.

The opposite conditions usually exist if the submarine's patrol area is on the high seas. It follows that an ASW strategy aimed at finding and destroying the opponent in the open ocean is highly dependent on strategic intelligence about his general whereabouts, strength, and direction of movement. Put another way, a hunt-and-kill (HUK) strategy without the benefit of strategic "cueing" has historically shown to be a cost-ineffective search for a "needle in the haystack."

Strategies of destruction in the transit areas have generally relied on minefields, sometimes backed up by mobile surface and air patrols that are linked to "bell-ringer" detection devices. A successful ASW barrier system will destroy few enemy submarines. After the first few losses, submarines are likely to be diverted to another and less dangerous route of passage; if this does not exist, they are effectively contained. The latter was the fate of the submarines of the Soviet Baltic Fleet during World War II. From the spring of 1943 until the capitulation of Finland in September 1944,

the German-Finnish "Walross" barrier of steel nets, mines, and mobile patrols across the Gulf of Finland excluded the Soviet underwater flotillas from the Baltic Sea.

Destruction strategies in the patrol areas have been practiced in two basic and one "hybrid" forms. The basic forms are "offensive" HUK, and "defensive" armed escort of the targets of the submarine, i.e. the convoy system. Between the two falls the system of "protected lanes" or defense of the so-called "focal points" of friendly shipping. This last strategy basically proposes to combine intensive HUK and close escort operations in the approaches to ports and harbors where seagoing traffic is "funneled," and where enemy submarines may be expected to concentrate. Although a failure in the past, some Western naval planners today believe that, between much improved detection capabilities and a shortage of convoy escorts, the strategy can and must work.

Today, as in the past, the prospect of a HUK strategy is vitally dependent on strategic cueing. During World War II, Allied "hunting groups" achieved spectacular successes thanks to two sources of "strategic" intelligence: (1) the interception and location of U-boat radio traffic through high-frequency direction-finding (HD/DF), and (2) the de-cryption of the U-boat fleet's "Triton" cipher. Contemporary strategic intelligence about enemy submarine movements still relies, in part, on communication interception. The ASW plans of the major powers cannot depend, however, on a repeat of the Triton-breaking success of World War II's "Ultra" group. Instead, billions of dollars and rubles have been and are being invested in extremely long-range acoustic and non-acoustic ocean floor-mounted and satellite-carried ASW "early warning" systems.

Today still, the convoy system is frequently labeled a "defensive" ASW strategy and, by connotation, "inferior" to "offensive" HUK. The record of the two world wars is this: (1) the convoys were the single most successful means for defeating the purpose of the U-boat, i.e. sever the Allies' economic and military

arteries, and (2) ships and aircraft on convoy escort duty destroyed more submarines than did their counterparts that engaged in HUK operations.

ASW Strategies of Containment

Destruction of the enemy's submarines is a bonus; the essential purpose of the ASW strategist is to defeat the war-fighting purpose of his opponent. Containment strategies have historically depended on physical obstruction of the submarine's movements, including minefields, nets, and "blocking ships." The creation of the strategic missile submarine has added the idea of psychological containment by similar ("countervailing") forces.

The advantage of an ASW strategy of containment is twofold: (1) it minimizes the risk of casualties that is part and parcel of destruction strategies, and (2) it reduces the need for current intelligence about the submarine enemy's plans and movements; in theory at least, all the ASW defender needs doing is to find the right "cork" to "bottle up" the opponent. The disadvantage of containment is also twofold: (1) it is quite difficult to create a hermetically-sealed barrier, and (2) containment schemes are likely to tie up forces that are badly needed elsewhere.

Containment at the Source

Most close-in ASW containment schemes have relied on minefields. Few have proven effective for the same basic strategic reason that has historically deterred "fleet action" against the sources of the submarine. Success in mine warfare ultimately depends of the relative stamina of the two sides, i.e. the relative persistence of the mine-layer and the mine-clearer. The Allied mine-laying campaigns of the two world wars failed to contain the U-boats inside their bases because the Allied navies were unable or unwilling to patrol the fields within easy reach of enemy counter-attack, and prevent the Germans from clearing a safe passage through the cordon.

British efforts in World War I to contain the U-boats inside their bases by sinking blockships failed, in part, for the same reason. On April 22-23, 1918, a Royal Navy flotilla "practiced" a small-scale version of Admiral Jellicoe's proposal to close off the U-boats' Heligoland Bight exits by sinking 83 old warships filled with concrete. Two blockships were laid athwart the channel to the U-boat base at Zeebrugge on the Flanders coast. The physical portion itself of the operation was successful, but, within less the one month, the U-boats were back-in-business thanks to a channel dug around the obstruction. The operation, for all its gallantry and ingenuity could have been no more than a short-lived success as long as the British fleet was not prepared to guard against enemy efforts to remove the obstacle.

Containment in the Transit and Patrol Areas

"Static" containment strategies without the presence of mobile reactive forces have proven equally unproductive in the submarine's transit and patrol areas. The basic problem is that a determined submarine opponent is likely to eventually find means and methods to find or "create" a crack. The most famous (if not most successful) anti-transit barriers of the two world wars were the Dover and Northern "barrages." The first one involved a combination of minefields and "tripwires" laid across the English Channel; the second depended on tens of thousands of mines planted in the Greenland-Iceland-United Kingdom (GIUK) "gap." The World War I version of the Dover Barrage failed during most of its lifespan due to the British failure to maintain reactive patrols after daylight hours and the winter months from December through April. Its World War II variant was circumvented by the German occupation of France. The Northern Barrage of the "Great War" stretched across the 400 kilometers of water that divide the Orkney Islands from Norway. Established in the spring of 1918 (when the convoy system had already proven its effectiveness), the system proved more dangerous to the Allied mine-laying force than to the U-boats. The tendency of the mines to explode prematurely was part of the problem; more

important, the Allied patrol ships that were to harass the intruders and force them into the deep minefields, were withdrawn for other duties. Four-to-six U-boats were lost on the barrier. A single U-boat may have fallen victim to World War II's northern barrage; more Allied ships were lost to mines broken loose from their moorings.

Contemporary barrage schemes combine containment and destruction tactics, using "smart" mines (such as the American Mk 60 "encapsulated torpedo," or Captor), mobile or stationary acoustic "fences," and long-range patrol aircraft. One possibility is to completely encircle the submarine's suspected patrol area with air-dropped acoustic buoys, and the methodically shrinking the fenced area by placing one buoy row inside another until the enemy has been pinpointed for final prosecution.

Strategies for Limiting the Submarine's War-Fighting Efficiency

If the enemy submarine cannot be destroyed or contained, yet is denied the full use of its destructive capabilities, the ASW strategist has achieved his purpose. The choice of efficiency-limiting strategies begins at home, and is dependent on the war-fighting purpose of the enemy submarine fleet. For example, if the purpose is economic strangulation, the ASW defender may counter by reducing his dependence on seaborne commerce (e.g., food rationing, boosting domestic sources of supplies). If the threat is one of strategic missile attack, various passive and active "damage limitation" measures are possible.

Limiting Efficiency at the Source

One possible method to degrade the submarine's operational efficiency has already been mentioned, namely the mining of crew training areas. Production efficiency may be attacked by aerial "harassment raids," aimed at forcing yard workers to repeatedly stop

work and seek shelter. One of the hoped-for effects of the Allied city bombings was the lowering of the morale and hence fighting efficiency of U boat crews.

Limiting Efficiency in the Transit and Patrol Areas

The purpose of efficiency-limiting strategies in the transit or patrol areas is to minimize the submarine's productive patrol time. As already noted, the measure of success of a barrier system is not necessarily the number of submarines destroyed, but may be instead the extent to which the enemy is forced to seek an alternate and more time-consuming route. For example, the success of the "improved" Dover Barrage of 1917-18 lay in the forced re-routing of the U-boats via the more distant waters between Norway and Scotland.

A successful means in the past to degrade the submarine's productivity has been broad area search and surveillance by patrol aircraft. The tendency of the submarine to avoid an opponent who could look over-the-horizon was discovered by accident with use of kite balloons (ship-towed balloons with a human observer) in the Mediterranean theater in World War I. During World War II, the fear of airborne discovery forced the U-boats in transit through the Bay of Biscay to spend increasingly more time at slower underwater speeds. Similarly, an unquantifiable measure of effectiveness of the World War II convoy air escorts was the frequency that their mere presence forced the U-boats to break tactical contact, and look for easier prey elsewhere.

The submarine's productive period is determined, in part, by the amount of fuel and weapons it carries. The first consideration is irrelevant for the nuclear submarine, but the second is still so today. The implication is that a submarine, nuclear or otherwise, can be denied its full potential by interfering with its logistics infrastructure. The best-known illustration of this particular strategy is the systematic Allied campaign of World War II to

destroy the "Milch Cows"- the U-boats' fuel replenishment submarines.

The Foreseeable Future

The choice of ASW strategy is determined by two factors: (1) the prevailing balance between submarine and anti-submarine technologies, and (2) the particular war-fighting purposes of the submarine that need defeating. The foreseeable technological balance will hinge on (a) the submarine's "stealth" versus ASW detection capabilities, and (b) the ability of the ASW defender to attack the submarine quickly and accurately at "stand-off" ranges. As long as the oceans do not become "translucent," prospects are that the submarine will continue to evolve and assume tasks that have traditionally been the prerogative of surface fleets, for example, air defense of the aircraft carrier. New submarine roles will prompt a new "menu" of ASW strategies.

The table below compares the destructive productivity of different ASW methods during the two world wars. Not shown are submarine losses due to scuttling, collisions and other marine accidents, capture, or own forces.

Submarine Losses Due to Enemy Action in the Two World Wars

World War I					
	Surface ships ¹⁾	Aircraft ²⁾	Surface ships Submarines Mines ³⁾	and aircraft	Other Unknown Total.
Germany	73	1	18	48	19 159
Great Britain ⁴⁾	7	1	5	10	8 31

World War II					
	Surface ships	Aircraft	Surface ships Submarines Mines	and aircraft	Other Unknown Total.
Germany	246	349	21	26	7 29 728
Great Britain	25	5	4	27	- 7 69
United States	18	5	1	5	- 9 44
Japan	65	13	21	2	- 16 124
Italy	32	23	19	2	1 4 85
Soviet Union	20	5	5	41	1 43 115

1) includes naval and non-naval surface ships, using ramming, gunfire, explosive sweeps, and depth charges.

2) includes submarines destroyed in port.

3) includes losses "probably" due to mines.

4) includes 3 Canadian and 2 Australian submarines.

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