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13. ABSTRACT *(Maximum 200 words)*

This study examines a comparison of land-based antisubmarine warfare (ASW) operations using U.S. Army aircraft during World War II and the U.S. Navy's P-3 Orion during the Cold War. Through both wars, land-based ASW aircraft provided the U.S. military an outreaching arm that limited the striking potential of enemy submarines. This thesis investigates the comparison in more depth by using four of the nine principles of war: objective, offensive, maneuver, and surprise.

Deterrence was the national strategy used to keep submarines from becoming a potential aggressor during both wars. The Navy's P-3 Orion, land-based throughout the Atlantic, was able to provide a credible deterrent against Soviet submarines since its introduction to the fleet in 1962. U.S. Army aircraft of World War II used in fighting the German U-boats, on the other hand, progressed into a credible deterrent in their temporary role of ASW.

The author examines the short-lived history of U.S. Army land-based operations (approximately two years) and the extended history of the U.S. Navy land-based operations and suggests that despite technological advances onboard both service's aircraft, land-based ASW has changed very little after fifty years. This study also indicates that there lies a significant need in pursuing and continuing the capabilities of a land-based ASW aircraft.

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A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

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B.S., University of Nebraska, 1987

For Leavenworth, Kansas
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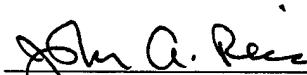
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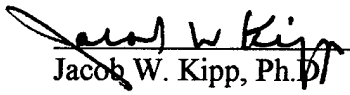
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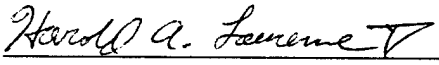
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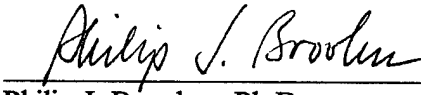
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ABSTRACT

A COMPARATIVE ANALYSIS OF LAND-BASED ANTISUBMARINE WARFARE OPERATIONS IN THE ATLANTIC: U.S. ARMY DURING WORLD WAR II AND U.S. NAVY DURING THE COLD WAR by LCDR Stanley J. Grabowski Jr., USN, 96 pages.

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ACKNOWLEDGMENTS

My profound thanks belong to my family which has been my pillars of strength throughout this study. For those that have been blessed with the privilege of knowing my wife Teresa realize that she has earned her angel wings many times over, this last year was no exception. More than anything, she has always encouraged me to not only do the impossible but also to excel at it. My two year old son Jacob has continuously shown me the true value of life. His daily visits to my office saying "Daddy when you're done studying we'll play" or "Daddy can I study too" made me realize that I was spending too much time in the office. My family's support throughout this study will always be remembered and cherished.

Being a Navy family we rarely get the opportunity to have Dad home everyday for a year, in this respect I thank the U.S. Army Command and General Staff College for giving me this opportunity. This combined with the formal course work of the college, interaction with my sister services and foreign military officers, and professional research truly made this "the best year of my life." Of course being three hours from my and my wife's hometown of Omaha, Nebraska wasn't bad either.

Dr. Jacob Kipp, Lieutenant Commander Harold "Tad" Laurence, and Mr. John Reichley offered me the utmost support even when my optimism looked bleak. They consistently provided me with the logical questioning and critical guidance that allowed me to continue on one day at time. Their professional expertise and coaching during the thesis' development were indispensable.

Lastly, I want to thank the soldiers and aircrewmen of the U.S. Army Air Forces Antisubmarine Command for persevering during their command's short-lived history. Their participation in an otherwise naval operation paved the way for future land-based ASW hunters such as myself. I salute their accomplishments and thank them for their contributions.

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CHAPTER 1

INTRODUCTION

On 12 July the aircrew prepared for another chance to display its antisubmarine warfare (ASW) prowess. This particular flight had special significance to the pilot. He was making his first operational flight as an aircraft commander. Operating 200 miles northwest of Lisbon, Portugal, the crew began its methodical search pattern at 5,600 feet. The weather was once again dismal, and the aircraft flew in solid overcast. Suddenly the monotony broke. The radar operator called out, "radar contact, bearing 180, range twenty-three miles." The pilot nosed the aircraft down and began his descent. As he set up his approach the radar operator continued to guide him in. Finally, at 200 feet the aircraft broke out of the overcast. The new aircraft commander spotted his target, a surfaced diesel submarine, one mile away off the starboard bow.[1]

One might believe that this naval engagement was recently conducted by a Lockheed P-3 Orion, the U.S. Navy's sole land-based ASW aircraft. However, the sequence of events described actually occurred more than fifty-five years ago, in 1943, and involved a Consolidated B-24 Liberator. And the aircrew was not Navy, it was Army. Its members were from the 480th Antisubmarine Group, a unit of the U.S. Army Air Forces (USAAF) Antisubmarine Command.

It is hard to imagine that the roots of land-based antisubmarine aviation can be found in the Army. But it was during World War II that the foundation of the U.S.'s sole land-based antisubmarine aircraft of today, the Navy's P-3 Orion, was laid. Numerous land-based aircraft, such as the Lockheed B-24 Liberator, Lockheed A-29 Hudson, North American B-25 Mitchell, and Boeing B-17 Flying Fortress, were the prime ASW aircraft of the war. World War II witnessed the development of a threat that these ASW assets were designed to counter. The German U-boat campaign in the Atlantic endangered the ability of the allies to sustain England, conduct strategic bombardment of the continent, and ultimately assemble the forces and means to reinvade Europe and defeat the German armed forces. ASW and land-based ASW were vital to countering this threat.

TABLE 1

SHIPPING LOSSES AND U-BOATS SUNK

Period	Ships Sunk by U-boats		U-boats Sunk
	Number	Gross Tons (1000)	By All ASW Means
Sept 39 - Dec 41	960	4,568	64
Jan 42 - Sept 42	878	4,575	50
Oct 42 - Jun 43	603	3,546	142
Jul 43 - Mar 44	192	1,150	215
Jun 44 - Aug 45	120	628	262
Total WW II	2,753	14,577	733

Source: Charles M. Sternhell and Alan M. Thorndike, Antisubmarine Warfare in World War II. Operations Evaluation Report #51. (Washington DC: Operations Evaluation Group, Office of the Chief of Naval Operations, 1946), 86.

This study focuses on the contributions land-based aircraft of both services made to antisubmarine warfare. Their existence grew out of a need to protect Allied merchant shipping from the deployed German U-boats during World War II and continued to meet the emerging, and very different, submarine threat of the Soviet Union during the Cold War. This land-based asset of the U.S. Armed Forces was able to provide the additional support needed to combat a menacing problem out at sea. This contribution was crucial in determining the outcome of both wars.

The Research Question

What lessons can be learned from the land-based ASW operations in the Atlantic by comparing those of the U.S. Army during World War II with the P-3 Orion of the U.S. Navy during the Cold War?

To answer the primary question, several secondary questions must be answered. First, what has been the nature of the changing submarine threat? Second, what conditions contribute to the successful employment of these aircraft? Third, what were the factors that led to land-based aircraft being used as ASW platforms? Fourth, how have the tactics used to pursue submarines changed over time? Finally, what assets were available to assist in the land-based aircraft's prosecution? A successful analysis of the lessons learned from the land-based aircraft of the USAAF and USN may prove useful to understanding ASW against the submarine threat the U.S. Armed Forces may face in the years ahead. These introductory comments will outline key definitions, provide some background, establish the scope of the effort, and highlight the significance of the study.

Definitions

Coastal Command. An organization within the Royal Air Force that was established in 1936 to seek out enemy ships and scout for the fleet. From late 1939, ASW became its overriding priority.[2]

Convergence Zone (CZ). Sound generated by a shallow object propagates downward into deep water then due to the pressure change refracts upward until it approaches the surface where the process is repeated until the sound has dissipated. The area where the sound converges near the surface is referred to as the convergence zone. Typical convergence zones occur about thirty miles from the source and again about sixty.[3]

Electronic Support Measures (ESM). A passive radar detection method by which a radar signal from another source, in this case a submarine, is detected, analyzed, and converted to a relative bearing.

Infrared Detecting Set (IRDS). Equipment that converts infrared radiation emanating from a heat source and displays the target image on a television-type display.

Long Range Aircraft. The baseline for a long-range (LR) aircraft is being able to patrol for two hours at a range of 800 miles.

Magnetic Anomaly Detector (MAD). An instrument designed to detect changes in the earth's magnetic field caused by a submerged submarine.

Operating Area. A geographical area assigned to either a submarine or land-based aircraft to conduct its stated mission. The boundaries are usually defined by lines of latitude and longitude.

Prosecution. Normally associated with one or more of the five ASW phases: search, localization, track, attack, and reattack.

Radar (Radio Detecting And Ranging). An instrument capable of transmitting a radio wave and receiving its echoed return to produce both a range and bearing to an object.

Sonobuoy. A small buoy discharged from an aircraft that is capable of transmitting sounds heard in the ocean back to the aircraft.

Threat. An expression of intention to inflict evil, injury, or damage; an indication of something impending.[4] In respect to the undersea operation of the submarine, it is the intention plus the capability.

U-Boat. Abbreviated form of the German *Unterseeboot*, undersea boat (i.e. submarine).

Very Long Range Aircraft. The baseline for a very long range (VLR) aircraft is being able to patrol for two hours at a range of 1,000 miles.

Background

World War I

A brief look at World War I sets the stage for the World War II airborne ASW aircraft. The German High Command launched a full-scale U-boat offensive against British shipping in 1916 with devastating effects. Their attacks reached a peak in the month of April 1917. In this month alone, 444 ships were sunk.[5] The need for an effective countermeasure against this destructive force came in the introduction of the convoy system which the British introduced during this same month. The results were

impressive. Through October 1917 only ten ships were lost while using the convoy system (less than 1 percent).[6] Land-based aircraft though proved to be nothing more than a defensive asset to assist in the location of the U-boats, and their range was their limiting factor. To cover the whole North Sea only one airborne asset was able to do so, the rigid airship. Despite the aircrafts' range limitation, they were attributed to have sunk six U-boats and proved they were at least an asset to consider. More importantly, they forced the U-boats to submerge in daylight hours and increase their transit time.

World War II

World War II and the Battle of the Atlantic began on 3 September 1939 when England and France declared war on Germany. Prior to the declaration of war, Germany had already deployed six of its U-boats at sea in the northeast Atlantic ready to conduct operations against merchant shipping in the western approaches to England.[7] The British, based on lessons learned from World War I, had already prepared plans to use the convoy system to protect shipping. On 6 September the first convoy set sail. To augment the protection of the ships the British also began using land-based aircraft of the Royal Air Force (RAF) Coastal Command. Most of these aircraft were of short range, approximately 250 miles. However, they also had a squadron of U.S. built Lockheed A-29 Hudsons that had more than double that range.[8]

The early stages of the war provide some insight into the immature status of land-based ASW aircraft, namely those of the RAF Coastal Command. During the first month of the war, acting offensively, their contribution to sinking U-boats was negligible. Equipped only with 100-pound bombs, they lacked both the skill and

weaponry to deliver a decisive attack. However, used defensively in support of the convoys, they had spotted approximately fifty U-boats and attacked thirty. Despite their lack of offensive firepower, they did cause U-boats to submerge, which prohibited them from making an attack.

Much like the early airborne ASW assets of World War II, the German U-boat was also not in its prime at the onset of the war. The Type VII U-boats seen initially in the Atlantic were nothing more than refined submarines that had fought the antishipping campaign of World War I. They were designed and suited for coastal waters, not for the prolonged Atlantic operations in which they found themselves operating in.[9]

In July 1935, the German High Command appointed Karl Doenitz as Officer Commanding Submarines. Doenitz, a veteran of World War I submarine warfare, had insight on how to build a submarine force that could work effectively on the high seas. He developed and practiced "wolfpack tactics" which allowed U-boats in a reconnaissance screen to swarm on a convoy. He knew the effectiveness of night attacks and massing combat power at a decisive point. And in 1938, he believed that a fleet of 300 submarines, of which 100 would be on patrol at any one time, had the potential to strangle Britain by destroying its merchant fleet. When the war came, instead of the 300 oceangoing submarines Doenitz seeked, he had less than sixty. Of the sixty, only half were able to conduct prolonged operations at sea and only ten were of the newest 500-ton class.[10]

On 8 December 1941, following the attack on Pearl Harbor and at the U.S. Navy's request, the Army Air Forces' First Bomber Command was ordered to begin

overwater reconnaissance on enemy shipping, in particular, submarines.[11] Until this time the German U-boat had become less and less effective against British-escorted shipping and sought a more profitable operating area. In January 1942 the U-boats headed west to the American East Coast.[12]

The Navy was ill-prepared for a land-based antisubmarine battle off the American shores, and thus the AAF found itself with a new mission: antisubmarine warfare. A good portion of its tactics and techniques was drawn from the now experienced RAF Coastal Command. Like the British, the combined efforts of both the convoy system and land-based aircraft proved beneficial in reducing the number of U-boat attacks off American shores against merchant ships. By late summer 1942 German U-boats were to move again, away from the land-based antisubmarine aircraft, first to the Caribbean then out to the mid-Atlantic.[13]

With the U-boats departing the American coast there were few attack opportunities for land-based aircraft. The Army sought to go on the offensive, out to where the submarines had transferred their operations. On 15 October 1942 the Army Air Forces Antisubmarine Command (AAFAC) was activated. The establishment of this new command reduced some of the restrictions held by the Navy and centralized control for the War Department. However, more importantly it gave the AAFAC latitude to go on the offensive anywhere. The AAFAC's mission was "the location and destruction of hostile submarines wherever they may be operating in opposition to our war effort and with assisting the Navy in the protection of friendly shipping."[14] The AAFAC's new

operating area was the North and Middle Atlantic from Newfoundland to Trinidad, from the Bay of Biscay to the approaches of North Africa.

The Army Air Forces Antisubmarine Command had a curtailed life. As part of a deal established with the Navy, the command was disbanded on 24 August 1943, and many of the Army's ASW B-24 Liberators were turned over to the U.S. Navy where they were redesignated as PB4Y-1s.[15] However, despite the disestablishment and a new leader of land-based ASW aircraft, Army Air Forces continued to hunt submarines, working with the British, until the end of World War II.

As World War II concluded, it was evident that both land-based aircraft and the submarine had expanded their technology and tactics in an aggressive fashion. The latter, however, would never be given the chance to use the full potential of its development, the German Type XXI submarine. Many historians have agreed that the German Type XXI was clearly capable of defeating the Allied ASW tactics of the time.[16] The 1,600-ton Type XXI had a planned speed of sixteen knots on the surface and eighteen knots submerged, and its batteries had the capability of running forty-eight hours submerged at six knots. At a cruising speed of six knots it had a range of 28,500 nautical miles.[17] Combine all this with its ability to snorkel, it could avoid overtake convoys, sprint away from surface escorts, and avoid radar detection. Its impact on the submarine community was such that all modern submarines are attributed to having descended from it. Michael A. Palmer in his book Origins of the Maritime Strategy states that the U.S. Navy still lacked the means to counter the Type XXI five years after the war.[18]

The Cold War

If World War I was the ASW precursor to World War II, then World War II was the ASW precursor to the Cold War. After the end of World War II the "big three," Soviet Union, United States, and Great Britain, decided to scuttle all but thirty of the surviving German U-boats and to divide the remaining U-boats equally among themselves. Of the ten U-boats the Soviet Union received, four were Type XXI. The Soviet Union was quick to build on submarine development where Germany had left off. By January 1948 the U.S. Joint Intelligence Committee estimated the Soviets had fifteen Type XXI submarines operational and within the next eighteen months they could have another forty-one.[19] A new submarine threat was quickly emerging.

During the Cold War there were numerous advances in the Soviet submarine program that built upon German technology. Each emerging new class of submarine was seemingly faster, quieter, and more powerful than its predecessor. In the course of its evolution there were some noteworthy milestones.

In 1952 the Zulu class emerged, with a total of twenty-six actually built. These were long-range, diesel-electric submarines that had an endurance of sixty days and a maximum submerged speed of sixteen knots. They were intended to conduct attacks against Atlantic shipping routes, distant reconnaissance missions, or deliver the unthinkable: atomic-warhead torpedoes against U.S. coastal cities. Five of the twenty-six Zulus were designed with two vertical launch tubes and were designated Zulu V.[20] These were the world's first ballistic missile submarines.

The first Soviet nuclear powered submarine class, the November, set to sea in 1958. There were thirteen of them built concluding in 1964. The early nuclear submarines encountered numerous engineering problems and suffered many setbacks. However, the November set new standards for both speed and operating depth. In January 1968 a November trailed the nuclear-powered USS *Enterprise* and maintained the chase submerged at thirty knots.[21]

TABLE 2

SOVIET SUBMARINE STRENGTH
END 1971

SSBN	Ballistic Missile (Nuclear), 16 missiles	19
SSBN	Ballistic Missile (Nuclear), 3 missiles	8
SSGN	Guided Missile (Nuclear)	40
SSN	Torpedo-Attack (Nuclear)	23
SSB	Ballistic Missile (Diesel), 2 or 3 missiles	25
SSG	Guided Missile (Diesel)	25
SS	Torpedo-Attack (Diesel)	210
	Total All Submarines	352

Source: Norman Polmar and Jurrien Noot, Submarines of the Russian and Soviet Navies (Annapolis, MD: Naval Institute Press, 1991), 199.

Construction of new submarines continued for the Soviet Union throughout the Cold War. Their peak strength was estimated around 440 submarines in the late 1950s.[22] As older submarines were decommissioned there was a period where the numbers being withdrawn were outpacing those entering the service. Since the

mid-1960s the numbers have maintained a balance of approximately 350 submarines. The sheer number and type of submarines the Soviet Union possessed changed yearly during the Cold War due to the continuous build up and advancements in technology. Table 2 provides a sample look at the Soviet submarine strength.

The surging growth of Soviet submarines was a clear indication that the Soviet Union would not limit patrols to regional waters, and patrols in the Atlantic were to be expected. On 3 March 1959 they were recognized publicly by Vice Admiral Charles E. Weakley when he noted that Soviet submarines had been detected within 500 miles of U.S. shores.[23] The patrols continued. During the Cuban Missile Crisis of 1962, five diesel-electric submarines were noted operating in the western Atlantic-Caribbean area. In 1969, beginning with the Yankee class, nuclear ballistic missile submarines began their patrols in the Atlantic. "The Battle of the Atlantic" had indeed returned, only this time with a much deadlier undersea opponent.

The Lockheed P-3 Orion was designed specifically to meet the submarine threat. Its predecessor was the P-2 Neptune, a descendant of the PB4Y-1 (a navalized B-24 Liberator). In 1962 the first operational P-3 emerged, and there have been an additional 652 aircraft made over the years. The U.S. Navy currently has approximately 300 in its inventory. The P-3 Orion, with its capability to cover large distances in short periods and to stay in an area for a long period of time, made it an attractive ASW asset. With a normal endurance of around twelve hours, it can fly more than 1,000 miles, pursue a submarine for four hours, and fly back to its home base. The P-3 has gone through three model changes thus far with the P-3C being the latest version.

Through the end of the Cold War the P-3 maintained its presence worldwide in order to counter the Soviet submarine threat. Twenty-four operational squadrons were maintained and operated out of naval bases on both coasts. Two bases covered the East Coast operating out of Brunswick, Maine, and Jacksonville, Florida, while two other bases covered the West Coast, San Francisco, California, and Barbers Point, Hawaii. From these bases the squadrons were able to deploy and cover global waters from fifteen deployment sites. The emphasis on P-3 worldwide coverage is summed up best by Admiral Herbert Ainsworth, "to be anywhere in the world in 30 minutes."[24]

Scope

A common framework for this comparison is needed which will assist in defining the lessons learned from these land-based ASW aircraft despite fifty-five years of technological changes and differing services. Both services reference such a common framework, the U.S. Army in Field Manual (FM) 100-5, Operations, and the U.S. Navy in Naval Doctrine Publication (NDP) 1, Naval Warfare. That common thread involves the principles of war. The nine principles of war are objective, offensive, mass, economy of force, maneuver, unity of command, security, simplicity, and surprise. For the purpose of this study four of these principles will be used to derive the comparison: objective, offensive, maneuver, and surprise.

Objective

"Direct every military operation toward a clearly defined, decisive, and attainable objective."[25] The objective is the desired end state, and it must be clearly defined to

focus the effort of the force. In every war there will be a strategic level objective that governs the course of action. At each echelon below strategic there are subsequent objectives linked to this overriding purpose. There should be no doubt as to how all other supporting efforts work together to achieve the overall end state.

Offensive

"Seize, retain, and exploit the initiative."[26] Offensive action is what every force on the battlefield strives for. It permits a force to set the terms and seize the opportunities that arise from its action. Taking the offensive ultimately denies the enemy the same freedom of movement and limits him to the terms of the aggressor. An offensive prosecution in antisubmarine warfare keeps the adversary busy defending itself and robbing it the potential to carry out its mission.

Maneuver

"Place the enemy in a position of disadvantage through the feasible application of combat power.[27] Maneuver is the dexterity to stay ahead of the enemy decisively, to gain and exploit the initiative. Inherent in manuever is the concept that the movement enhances both defensive and offensive capabilities. In terms of antisubmarine warfare it is the ability to get ahead of the submarine, the placing of a force in the optimum position so as to always have the advantage.

Surprise

"Strike the enemy at time of place or in a manner for which he is unprepared."[28] The element of surprise is a key element in antisubmarine warfare. Surprise can be

achieved by speed of attack and maneuver, varying tactics, or concealing capabilities. It can affect the outcome of a submarine engagement, battle, campaign, or even an entire war. It is not essential to take the enemy completely by surprise, but to cause him to become aware too late to react persuasively. Surprise has always been one of the most important factors in war, because it can make up for deficiencies in numbers.

Limitations

This study did not use any classified documents or sources. Though many of the source documents for the World War II era have been declassified, the Cold War era still has a substantial portion of them classified. However, the available sources were adequate for the purposes of this study.

Significance of the Study

ASW for decades has been a primary focus for the U.S. Navy. However, since the collapse of the Soviet Union and the end of the Cold War, ASW is no longer a primary focus. Early in 1991, Admiral Frank Kelso, the Chief of Naval Operations, alludes that power projection and not antisubmarine warfare was the Navy's number one priority.[29] With the end of the Cold War, U.S. National Security Strategy has shifted its interest to the more likely regional conflict scenario and into the littoral regions. Despite the change in venue, these are the very regions where submarines, in particular diesel submarines, prosper.

During the Cold War the land-based ASW arm of the U.S. Navy was mainly concerned with nuclear powered Soviet submarines operating in deep water. Much of

the experience that once flew these aircraft against the diesel submarines has been either lost or not used in quite some time. Now that the Cold War has ended and the focus is heading back toward the diesel submarine's operating area, the lessons learned from land-based ASW operations in both wars may have relevance. The U.S. Navy continues to seek out its next submarine threat whether it is a nuclear submarine, diesel submarine, or a combination of the two.

[1]Max Schoenfeld, Stalking the U-Boat (Washington and London: Smithsonian Institution Press, 1995), 100.

[2]Ibid., 9.

[3]J. R. Hill, Anti-Submarine Warfare, 2d ed. (Annapolis, MD: Naval Institute Press, 1989) 39.

[4]Webster's Ninth New Collegiate Dictionary (Springfield, MA: Merriam-Webster Inc., 1986), 1228-9.

[5]Charles M. Sternhell and Alan M. Thorndike, Antisubmarine Warfare in World War II (Washington: Operations Evaluation Group, Office of the Chief of Naval Operations), 1946), 1.

[6]Ibid. [7]Ibid., 3.

[8]Wesley F. Craven and James L. Cate, eds., The Army Air Forces in World War II: Volume One, Plans and Early Operations, January 1939 to August 1942 (Chicago: University of Chicago Press, 1948), 567.

[9]Montgomery C. Meigs, Slide Rules and Submarines (Washington DC: National Defense University Press 1990), 17.

[10]Ibid., 13-17. [11]Craven, 522-3. [12]Ibid., 515. [13]Ibid., 535-6.

[14]Headquarters of the Army Air Forces, Washington, File AAF 320.2 to Commanding General, Army Air Forces Antisubmarine Command, 28 December 1942, Combined Arms Research Library, Fort Leavenworth Kansas.

[15]Shoenfeld, 168.

[16]Norman Friedman, Submarine Design and Development (London: Conway Maritime Press Ltd., 1984), 53.

[17]Meigs, 143.

[18]Michael A. Palmer, Origins of the Maritime Strategy: The Development of America Naval Strategy 1945 - 1955 (Annapolis, MD: Naval Institute Press, 1988) 69.

[19]Ibid., 136. [20]Ibid., 148-54. [21]Ibid., 164-5. [22]Ibid., 169. [23]Ibid., 71.

[24]Wilbur H. Morrison, Wings Over the Seven Seas (South Brunswick and New York: A. S. Barnes and Co., 1975), 248.

[25]U.S. Army, FM 100-5, Operations (Washington DC, 1993), 2-4.

[26]Ibid. [27]Ibid., 2-5. [28]Ibid.

[29]Eric Beaudan, "Changing Course." Defense & Diplomacy (July-August 1991, 52-56), 54.

CHAPTER 2

LITERATURE REVIEW

> The riches that lie in countless repositories can be mined productively only if the seeker knows what he is looking for, where he may expect to find it, and how to recognize it.[1]
>
> Philip C. Brooks, Research in Archives

The purpose of this chapter is to review the existing literature on the land-based antisubmarine aircraft of the U.S. Army during World War II and the Navy's P-3 Orion during the Cold War. The main sources for this research have been archive documents, periodicals, government documents, Field Manuals, and various books by authors who have expertise in the airborne antisubmarine field. Secondary sources include information from service digests and the internet. The limitations are that much of the current capabilities and tactics of the P-3 Orion are classified and will not be discussed in this thesis. In order to weave the past and present into a sound basis for analysis, a variety of material was reviewed to ensure that the conclusions of the study encompassed both conventional wisdom and also historical aspects of ASW.

The works listed in this literature review represent significant sources discovered during the research process. The list of references is far from inclusive; however, a sufficient depth and breadth of material was available to complete the analysis within the scope of the study.

World War II Land-Based ASW

Operations Evaluation Report (OER) number 51, Antisubmarine Warfare in World War II, edited by Charles M. Sternhell and Alan M. Thorndike contains an excellent postwar compilation of antisubmarine warfare data. The report was initially released in 1946 and embodies the statistical and analytical work done during 1942 through 1945. The report is in two parts. Part I gives a chronological narrative of the U-boat and ASW forces throughout the war and is divided into seven periods. Each period of time revolves around the changes in U-boat tactics and strategy. Within each period a section is devoted solely to ASW aircraft and how they were being used to countermeasure the U-boat. Part II describes the analytical methods early operations researchers used to improve the Allies' antisubmarine effectiveness. The emphasis in part II is on the evaluation of both the tactics and equipment used. Of special interest were chapters 11, "Attacks by Aircraft," 13 "Offensive Search," and 14 "Employment of Search Radar in Relation to Enemy Countermeasures."

The backbone of chapter 4 is derived from the Army Air Forces Antisubmarine Command's Monthly Intelligence Report(s). The complete set of these original publications, from October 1942 to August 1943, was found in the archives section of the Combined Arms Research Library (CARL) at Fort Leavenworth, Kansas. Now unclassified, these publications contain valuable information that was derived from highly secret sources and were disseminated for use by higher commanders and their staffs, squadron commanders, and combat crews actually engaged in antisubmarine warfare.

The contents of the Monthly Intelligence Report(s) varied in the first few reports; however, by the February 1943 report the contents began to have a structured format. The first few reports had a section on "Interesting Aircraft Attacks on Submarines." As noted in chapter 1, there initially was no plan in existence to employ the Army Air Forces' aircraft in antisubmarine warfare, therefore this section described some of the tactics, procedures, and maneuvers that were working not only for AAF crews but also RAF and Navy crews. By February 1943 this section was replaced by "Analysis of Anti-Submarine Warfare." The new focus showed attacks on enemy submarines and also AAFAC operations, orders of battle for the aircraft, primary antisubmarine air efforts, and summaries of antisubmarine warfare.[2] Through each successive monthly report it was easy to discern how efficient and productive the Army Air Forces Antisubmarine Command was becoming.

Equally invaluable to understanding and describing the AAFAC's perspective on antisubmarine warfare was its Standard Operating Procedures (SOPs). These original documents, also found at CARL, detailed the guidelines by which the ASW crews were to conduct their missions, at least in the beginning stages. The SOPs found were all from December 1942, two months after the activation of the AAFAC. Since there was no precedent for the Army Air Forces to follow, these initial guidelines were as current as could be expected. With the growth of the AAFAC came the growth of its doctrines of techniques and tactics, many of which were found in the Monthly Intelligence Report(s). These SOPs, however, did assure uniformity and gave guidance to the combat aircrews.

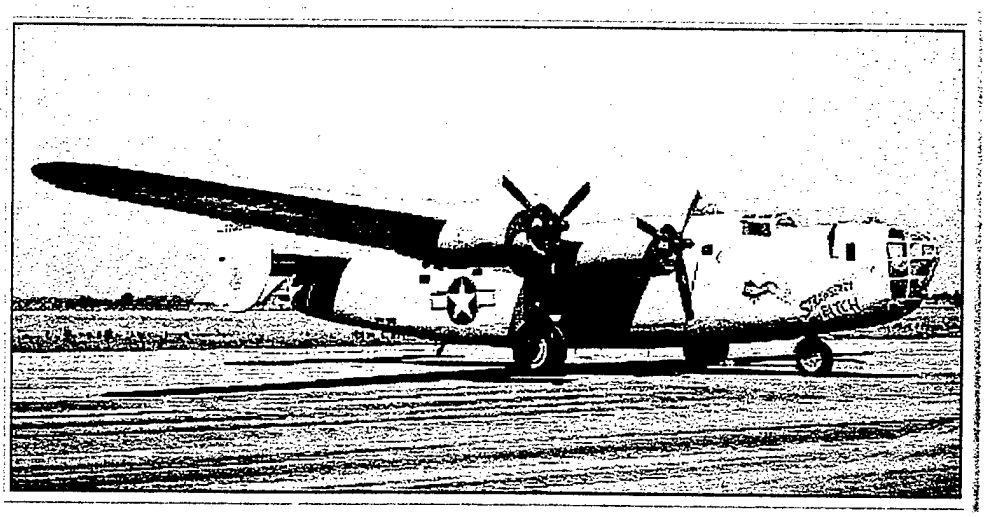

Figure 1. The Army Air Forces' Consolidated B-24D Liberator. The best weapon available in World War II for the purpose of antisubmarine warfare. Source: [Online] Available Pierce College Library Homepage http://www.pierce.ctc.edu/Users/Facpages/pscott/B24d.htm, February 4, 1998.

Stalking the U-Boat is the one book found that attempts to bridge the gap in ASW history left by the USAAF's Antisubmarine Command. The author, Max Schoenfeld, in particular focuses on only two of the Antisubmarine Command's groups, those that were outfitted with B-24 Liberators (figure 1) and deployed to the east side of the Atlantic. The 480th Antisubmarine Group was the first to deploy overseas, in late November 1942,[3] with the 479th Antisubmarine Group following in June 1943.[4] Schoenfeld states that the last written work he was aware of at the time he wrote his book was a chapter in W. F. Craven and J. L. Cate, editors, The Army Air Forces in World War II: Volume Two, Europe: TORCH to POINTBLANK, August 1942 to December 1943, published in 1949. He further notes that since that book, "This interesting episode in the development of modern air power, with its varied lessons and experiences has remained largely ignored."[5]

The 479th and 480th Antisubmarine Groups were at the pinnacle of land-based antisubmarine warfare in 1943. They flew the preferred ASW aircraft of the time, the B-24D, and were comprised of experienced ASW crewmen.[6] While they accounted for only 15 percent of the AAFAC's flying time, they accounted for 71 percent of its attacks on U-boats.[7] Schoenfeld helps portray the overall initiative of the AAF authorities who all preferred an offensive strategy in antisubmarine warfare as opposed to the Navy's commitment to the convoy system which he describes as a defensive strategy.[8] He vividly recounts numerous events and missions where the aircrews flew many hours seeking to destroy U-boats or at least force them to remain underwater. Schoenfeld also describes many of the developing advancements made in antisubmarine warfare to include the centimetric radar which was first used in these Antisubmarine Groups.

Cold War Land-Based ASW

In the midst of the Cold War, on the 6th and 7th of October 1977, a conference was sponsored by the American Enterprise Institute (AEI). The Problems of Sea Power as We Approach the Twenty-First Century, edited by James L. George, contains the proceedings of this conference and enabled the author to gain a perspective of the present and future of land-based antisubmarine aircraft based on the experts and policy makers of 1977. Present at this conference were a few notable individuals to include: the Deputy Chief of Naval Operations for Plans, Policy and Operations, Vice Admiral William Crowe; Former Chief of Naval Operations, Admiral (retired) Elmo R. Zumwalt; Director Navy Systems Analysis Division, Rear Admiral C. A. H. Trost; Chairman of the

House Seapower Subcommittee, Congressman Charles E. Bennett; and Norman Polmar of the Sante Fe Corporation, who in 1991 wrote Submarines of the Russian and Soviet Navies, 1718 - 1990.

One of the most easily read, yet informative, books used to formulate chapter 5 was Anti-Submarine Warfare, by J. R. Hill. Rear Admiral Hill was a member of the British Ministry of Defense's central staff, and he captured the essence of antisubmarine warfare and packed it dynamically into 128 pages. Surprisingly, he was neither a submariner nor an antisubmarine specialist. He even states that his lack of personal experience may have worked in his favor when writing this book since there was no need to hold back a desire to put out excessive technical knowledge.[9] Chapter 3, "The Means," provided valuable information for the thesis by describing both acoustic and nonacoustic detection, as well as the overall antisubmarine process, in an unclassified format.

Information on the P-3 Orion was generated from several unclassified sources. Of these sources a few noteworthy publications are worth mentioning. The Bible for any Navy aviator is his Naval Air Training and Operating Procedures Standardization (NATOPS) manual for his particular aircraft. Commonly known as the big blue sleeping pill due to its thickness and extensive text, the NATOPS manual standardizes both ground and flight procedures without including tactical doctrine. It encompasses the various aircraft systems, operating limits, flightcrew coordination, mission systems, and both normal and emergency procedures. Professionally, it provides the basis for development of efficient and sound operational procedures as well as a positive approach

toward improving combat readiness. The manual used for the development of this thesis was the NFO/Aircrew NATOPS Flight Manual, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-1.1.

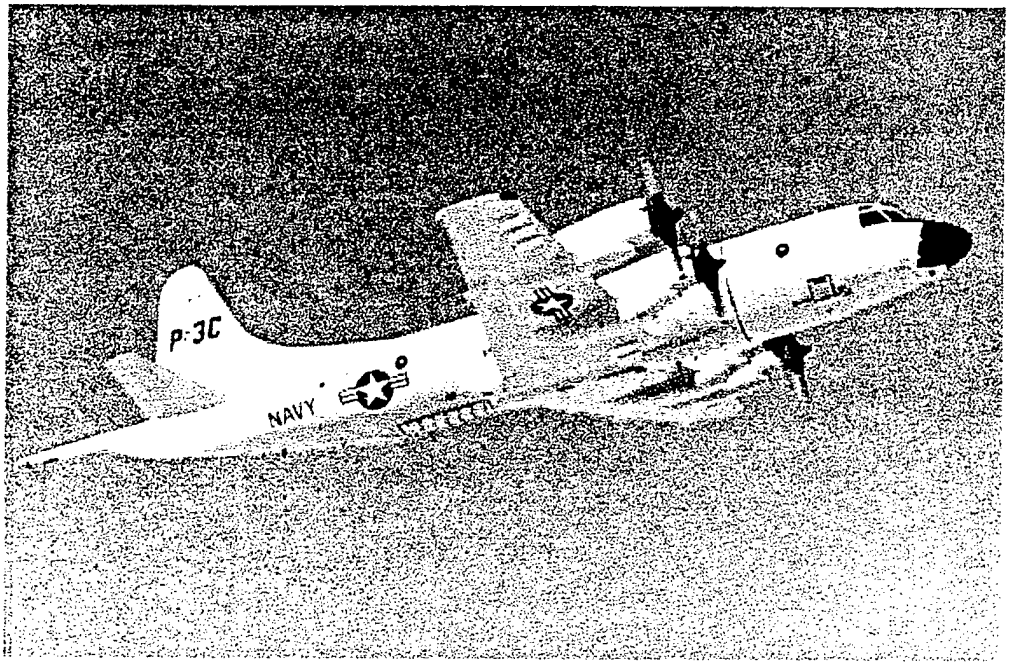

Figure 2. The U.S. Navy's Lockheed P-3 Orion. The sole land-based antisubmarine aircraft for the U.S. Navy. Note the external sonobuoy launch tubes (SLTs) in the lower fuselage and MAD boom protruding from the tail. Source: [Online] Available Lockheed Martin Homepage Photo Gallery http://www.lmasc.lmco.com/lmascx/photo/p3.html, February 4, 1998.

Patrol Squadron Thirty (VP-30) is currently the sole P-3 fleet replacement squadron (FRS) for the U.S. Navy. It operates out of Jacksonville, Florida. During the Cold War, VP-30 was the training squadron for the Atlantic Fleet patrol aviation community, while VP-31, located at NAS Moffett Field in California, provided the training for the Pacific Fleet. Shortly after the Cold War and during the drawdown of

the military, which included P-3 squadrons, VP-31 was disestablished. VP-30 indoctrinates and trains fleet replacement pilots, naval flight officers, aircrewmen, and maintenance personnel to operate and maintain the P-3 Orion (figure 2). It is the focal point for initial training in antisubmarine warfare.

A number of VP-30 training manuals provided useful information for chapter 5. The Instructional Materials Library (IML) booklets, which are no longer used by the training squadron, are a condensed reference on various antisubmarine warfare and P-3 topics. Their topics included focus areas such as sonobuoys and sonobuoy characteristics, and navigation systems block diagram and signal flow. The initial six-foot stack of these publications issued to the author in 1987 has now through the years been reduced to a foot and a half; however, much of their contents are just as valuable today as they were then.

ASW Post Cold War

Since the end of the Cold War, quite a few authors have written along the same theme as Rear Admiral (retired) Thomas A. Brooks' February 1996 U.S. Naval Institute Proceedings article, "Whatever Happened to ASW?" Articles such as this one reflect on happier times for a land-based submarine hunter, back to when the U.S. Navy proclaimed that ASW was its top priority during the Cold War. Rear Admiral Brooks, like many others, is concerned that "the submarine threat has by no means gone away" and that countries such as Russia and China are improving their capabilities "at the same time that our emphasis on ASW has declined."[10]

Of course with a "supposed" reduction of a submarine threat, quite a few articles reflect on what role, if any, the P-3 Orion will play in the years ahead. Lieutenant Commander Kenneth B. Sherman's article "Orion the Hunted" and Commander Scott Jasper's article "Does Maritime Patrol Have a Future" both describe a diminishing outlook for the P-3, but on a different theme. Sherman describes the "defenselessness" of the P-3 while on an ASW mission, with respect to both surface and subsurface missile threats.[11] Jasper on the other hand sees the P-3 nearing the end of its service life in 2010, with no replacement currently on line.[12]

The U.S. Naval Institute Proceedings provided the author numerous articles and perspectives on ASW for this thesis, to include Sherman's and Jasper's. One article in particular sparked some interest in this research because it was a World War II threat (a diesel submarine) wreaking havoc in the Cold War environment. "Remember the *San Luis*!" cites Captain (Retired) Charles H. Wilbur who wrote this informative article on this submarine for U.S. Naval Institute Proceedings in March 1996. The *San Luis* was an Argentine submarine, a German Type 209, that was engaged against Great Britain in the Falklands Conflict in 1982. His genesis for this article has been touched on by many other authors listed in this thesis' bibliography. That if one single submarine, in this case a diesel submarine, "could operate with impunity against the best of the Royal Navy in the South Atlantic, we [the U.S. Navy] cannot allow our nation to become complacent."[13]

Captain Wilbur further elaborates that it is imperative that the U.S. citizens, Navy, and government officials are made aware that the end of the Cold War did not

equate to the end of the submarine threat. Russia continues to build submarines, both nuclear and nonnuclear, as well as sell them. Various European nations, including Germany, continue the development of submarines, to include unconventional air-independent propulsion submarines. Using the *San Luis*' success against Great Britain's ASW force, Wilbur reminds everyone that ASW is a "difficult, challenging, and deadly game" and the post-Cold War submarines will further test our ASW forces.[14]

[1]Philip C. Brooks, Research in Archives (Chicago and London: The University of Chicago Press, 1969), 1.

[2]U.S. Army, Monthly Intelligence Report: February 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 7-14.

[3]Max Schoenfeld, Stalking the U-Boat (Washington and London: Smithsonian Institution Press, 1995), 38.

[4]Ibid., 140. [5]Ibid., ix. [6]Ibid., 3. [7]Ibid., 161. [8]Ibid., 2.

[9]J. R. Hill, Anti-Submarine Warfare, 2d ed., (Annapolis, MD: Naval Institute Press, 1989), 7.

[10]Thomas A. Brooks, RADM, "Whatever Happened to ASW?" U.S. Naval Institute Proceedings (February 1996), 13.

[11]Kenneth B. Sherman, LCDR, "Orion the Hunted." U.S. Naval Institute Proceedings (October 1986, 90-92), 91.

[12]Scott Jasper, CDR, "Does Maritime Patrol Have a Future?" U.S. Naval Institute Proceedings (April 1997, 74-77), 74.

[13]Charles H. Wilbur, "Remember the *San Luis*!" U.S. Naval Institute Proceedings (March 1996, 86-88), 88.

[14]Ibid., 86-7.

CHAPTER 3

RESEARCH METHODOLOGY

This study began as a thesis on Navy ASW aircraft only. However, after reviewing the literature in order to develop the scope on the Navy's ASW aircraft, the author came across Max Schoenfeld's Stalking the U-boat, the untold story of the U.S. Army Air Forces' antisubmarine operations against German U-boats. The author's unfamiliarity with the Army's role in ASW anchored the starting point for a thesis. The AAF highlighted an important contribution in antisubmarine warfare made by a sister service that could not be ignored. Schoenfeld perhaps accounts for the author's lack of knowledge by stating that "the U.S. Navy, emerging from World War II in sole possession of the antisubmarine mission, had no reason to preserve the memory of the USAAF's activities in that area."[1] This thesis attempts to resurrect this memory.

The purpose of this chapter is to describe the research methodology used to determine whether there is any correlation that leads to lessons that can be learned when comparing land-based antisubmarine aircraft of two different services, nearly fifty years apart, operating in the same body of water, the Atlantic. The research question is: **What lessons can be learned from the land-based ASW operations in the Atlantic by comparing those of the U.S. Army during World War II with the P-3 Orion of the U.S. Navy during the Cold War?**

This research comprises two major functional divisions. The first relies on the historical method to establish the evidence to answer the subordinate research questions. The second relies on the comparative method to establish the criteria needed to answer the research question. It is often possible to obtain more than one correlation within a study. The task is to represent the framework in which the correlation can be represented.

The discussion of the research will occur in three chapters. Chapter 4 analyzes the U.S. Army's ASW aircraft in World War II. Chapter 5 analyzes the U.S. Navy's P-3 Orion in the Cold War. Chapter 6 offers conclusions and provides the lessons learned as they apply to the four principles of war discussed.

This study primarily uses historical research as the method to develop chapters 4 and 5. The data was drawn mainly from military doctrinal manuals, books, unit histories, and primary and secondary historical documents. The third floor of the Combined Arms Library (CARL) provided invaluable historical material that enabled the author to relish in original World War II documents. An adequate amount of information was available to cover all aspects of this study.

As discussed broadly in chapter 1, the principles of war are the thread used to tie together the comparison and formulate the lessons that can be learned. Chapter 6 primarily uses the comparative method with the principles of war as its framework. The principles of war are the enduring bedrock of U.S. military doctrine.[2] The Army first published the discussion of the principles of war in 1921; the Navy in 1994. However, these principles have been around for many years prior and have withstood the test of

time. They provide the basis of the Army and Navy's warfighting capabilities on land, sea, or air.

Although all nine principles of war could have been used to help in the analysis, four of the nine best represent the role of the antisubmarine aircraft: surprise, maneuver, offensive, and objective. This does not mean that the other five are less important. Samuel B. Payne Jr. in his book The Conduct of War describes that there are two possible styles of warfare, attrition and manuever. He further states that in most situations, attrition warfare is best to achieve the principles of mass, economy of force, unity of command, security, and simplicity, while manuever warfare emphasizes the principles of surprise, maneuver, and the offensive.[3] The principle of objective is common to both styles. Based on the author's experience of flying against submarines, the author agrees with Payne's statement.

Subordinate Questions

To answer the research question, several subordinate questions needed to be researched and answered:

What conditions determined the aircraft's success? Success as defined by Webster is "a favorable termination."[4] Therefore, to answer this question the research determined the military objectives and strategic strategy of the U.S. as they applied the ASW aircraft. While it is true that the ultimate determination of success for an antisubmarine aircraft would be the destruction of a submarine, it is not true that the aircraft must destroy a submarine to be successful. As Vice Admiral William Owens, the Deputy CNO for Resources, Warfare Requirements and Assessment, stated in 1993, "In

today's world, it may be enough just to know where the other submarines are. As long as they are not interfering with our [the U.S. Navy] primary mission, all we need to know is where they are and how to avoid them."[5]

What were the factors that led to land-based aircraft being used as ASW platforms? The working premise behind this question is that the existence of the antisubmarine aircraft is the result of the deliberate actions of an attacker, a submarine. With numerous antisubmarine assets available to the U.S. military, the research keys in on those factors that allowed it to be a key asset.

What were the tactics used to prosecute the submarines? Although many of the tactics used by the P-3 are still classified, the unclassified strategy and military art of its capabilities are widely known and published. For the purpose of this research the unclassified tactics more than sufficed for the correlation. In FM 100-5, Operations, the Army refers to tactics as "the art and science of employing available means to win battles and engagements. Tactics is battlefield problem-solving usually rapid and dynamic in nature."[6] The battlefield for the ASW aircraft is the open ocean, in this case the Atlantic, and the difference between success and failure for the prosecuting antisubmarine aircraft can be measured in seconds. After fifty years this is still true.

What assets were available to assist in the prosecution? The premise for this question acknowledges that technology has obviously improved the antisubmarine aircraft's ability to locate and track submarines. However, the technological innovations by both the friend and the foe over the years have progressed to represent a ping-pong match. Once either the submarine or the aircraft developed a measure to enhance its

ability over the other, the other would develop a countermeasure. Therefore when placed into perspective, it could be argued that the difficulty of locating a submarine in World War II would be comparable to the difficulty of locating a submarine in the Cold War.

[1]Max Schoenfeld, Stalking the U-Boat (Washington and London: Smithsonian Institution Press, 1995), 171 .

[2]U. S. Army, FM 100-5, Operations (Washington, DC: Department of the Army, 1993), 2-4.

[3]Samuel B. Payne Jr., The Conduct of War (New York: Basil Blackwell Inc., 1989), 154.

[4]Webster's Ninth New Collegiate Dictionary (Springfield, MA: Merriam-Webster Inc., 1986), 2282.

[5]William A. Owens, VADM., "Still a Priority," U.S. Naval Institute Proceedings (March 1993, 124-129), 124.

[6]U. S. Army, FM 100-5, Operations (Washington, DC: Department of the Army, 1993), 6-3.

CHAPTER 4

ANALYSIS OF U.S. ARMY ASW AIRCRAFT

The U-boat has no more to fear from aircraft than a mole from a cow.[1]

Admiral Karl Doenitz
The Defeat of the German U-Boats: The Battle of the Atlantic

A Brief Overview of the Army Air Forces

With the United States' entry into World War II, the Army Air Forces assigned the First Bomber Command on the Atlantic Coast a mission of overwater reconnaissance.[2] On 8 December1941, when the First Bomber Command began antisubmarine patrols, its crews were neither trained nor equipped to perform the task demanded of them.[3] Nonetheless, they haphazardly began their patrols along the eastern coast of the United States.

By the end of January 1942, the First Bomber Command had in its antisubmarine service a total of 119 aircraft. Of the 119, only forty-six were actually considered mission capable, and of these, nine were B-17s.[4] The B-17s provided the long-range patrols out to sea the medium-range aircraft lacked. The First Bomber Command patrols averaged two flights per day, with three planes in each flight.[5] They operated out of four fields: Bangor Field, Maine; Westover Field, Massachusetts; Mitchel Field, New York; and Langley Field, Virginia (figure 3).

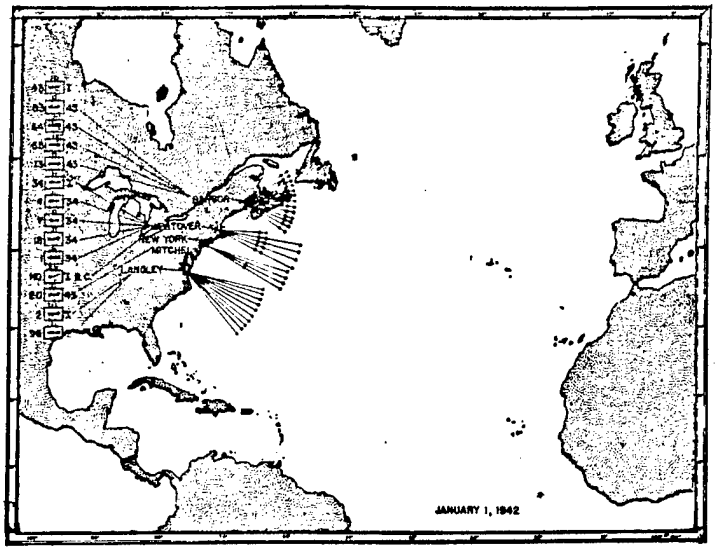

Figure 3. Location and Range of First Bomber Command Squadrons. Source: U.S. Army, Monthly Intelligence Report, July 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 14.

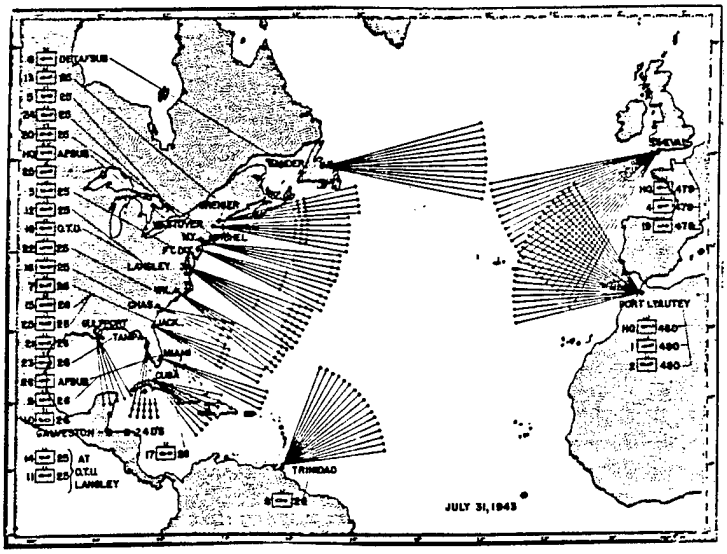

Figure 4. Location and Range of Army Air Forces Antisubmarine Command Squadrons. Source: U.S. Army, Monthly Intelligence Report, July 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 15.

On 15 October 1942 the First Bomber Command emerged as the Antisubmarine Command. With the new title also came an expansion of its patrolling area and the ability to take the fight to the German U-boat.[6] In its ten month existence, the AAFAC operated extensively out of four continents on both sides of the Atlantic in its attempt to locate and destroy German U-boats (figure 4). Near the end of its existence, the AAFAC was operating with more than 200 aircraft, 133 of which were long-range.[7]

These land-based aviation assets of the Army Air Forces' First Bomber Command and Antisubmarine Command pioneered the development of antisubmarine strategy, training, tactics, and equipment.

Strategy

The aim of ASW for the AAF in World War II was not the total destruction of the submarine threat, but rather to prevent enemy submarines from accomplishing their mission. According to Admiral Doenitz, Commander in Chief of the German Navy, the major objective of his submarine fleet during World War II was "to destroy more enemy tonnage that can be replaced by all our enemies put together."[8] The primary mission of the AAF in the campaign against German submarines was the protection of this tonnage (merchant shipping).

Table 3 shows the monthly analysis of the AAF's antisubmarine effort during the First Bomber Command's protection of merchant shipping. Although not decisive in the destruction of U-boats, the antisubmarine effort of the AAF is attributed to reducing the number of ships sunk and driving the U-boats away from the U.S. East Coast.[10]

TABLE 3

ANTISUBMARINE EFFORT
First Bomber Command's Area of Responsibility

	Aircraft Patrols	Submarines Sighted	Submarines Attacked	Ships Sunk by Subs
Dec 41	350	0	0	0
Jan 42	300	10	7	10
Feb 42	600	12	12	15
Mar 42	1250	27	26	32
Apr 42	1950	30	26	25
May 42	2100	23	12	51
Jun 42	1650	41	29	33
Jul 42	1950	23	16	20
Aug 42	1850	14	8	2
Sep 42	1800	14	2	1
Oct 42	1750	3	1	0
Total	15,550	196	139	189

Source: U.S. Army, Monthly Report, October 1942 (New York: Army Air Forces Antisubmarine Command, 1942), 6-8.

By mid-summer 1942 it became evident to the AAF that Admiral Doenitz was beginning to pull his U-boats away from the eastern coast to less defended waters.[11] The Army was left to look at the two schools of thought on how its land-based aircraft should be used in the protection of shipping. First, as the Army believed, it should be used offensively to strike out and attack the enemy.[12] Take the fight to the enemy. Second, as the Navy believed, it should be used defensively as an extended arm of convoy coverage.[13] In October the AAF, with the advent of its new Antisubmarine Command, chose to take the fight to the enemy.

Training

Antisubmarine warfare techniques and tactics for Army Air Forces' land-based aircraft initially evolved with the Army Air Forces' units themselves. There was no precedence in the Army for them to fall back on.[14] Many of the early valuable lessons in ASW came from the operational missions the First Bomber Command were thrust into and interaction with British liaison officers from the experienced Coastal Command of the Royal Air Forces.[15]

The Army Air Forces, nearly a year after its introduction to ASW, began its formalized training and standardization in antisubmarine warfare on 7 December 1942. The 18th Antisubmarine Squadron was relieved of its tactical responsibilities and became the Operational Training Squadron (OTS).[16] The first class began at Langley Field, Virginia, and focused on training in the best ASW platform then available, the B-24 Liberator.[17] Training had three areas of concentration and was broken into phases. The first phase involved aircraft familiarization in both day and night flights. Phase two consisted of bombing and gunnery. Phase three trained the aircrew on navigation skills, radar usage, and the antisubmarine mission.[18]

Tactics

The antisubmarine tactics indoctrinated by the Army Air Forces for their land-based aircraft were twofold. First, they were effective in searching and attacking enemy submarines. Second, they were used to harass the submarine.

Search

The search plans, as issued by the AAFAC's SOP, were based off of the speed and detection range of the aircraft against the submarine. The sensors available for detection were visual and, if installed, radar. The search rate of the patrolling aircraft was equal to the speed of the plane times the search width (twice the detection range).[19] For a B-24 with a radar detection range of ten miles, the area that could be searched would be 140 mph x 2(10 miles), which equaled 2,800 square miles that could be searched in one hour. For the same aircraft without radar and a visual range of five miles, only half the area could be searched in the same amount of time.

Visual Search

The search phase of the prosecution was a test in endurance for the aircrew. Numerous hours of flying were spent with the primary sensor to the search being visual. Trying to find a submarine in the vast open ocean was like trying to find the proverbial needle in a haystack.

The visual search for the U-boat was the only search asset available for many AAF aircraft. Even with the advent of other search sensors to be added to the aircraft, the human eye still became the determining factor between a contact and no contact. This required the crewmembers to be vigilant and alert at all times. Using a radar equipped B-24 as an example, each crewmember played an vital role in the visual search of the submarine. Of these twenty-four sightings in table 4 only six were preceded by radar contact.[20] The higher number of contacts made by the pilot and co-pilot are understandable since the nose of the aircraft is the first part of the aircraft to examine a

new view of the ocean. Also, the demands of the navigator, radar, and radio operators required constant attention within the aircraft and limited their time spent assisting in the search.

TABLE 4

VISUAL SIGHTINGS BY THE 1ST AND 2ND ANTISUBMARINE SQUADRONS
(Operating Out of Africa and England)

Pilot	7	Bombardier and Navigator	1
Pilot and Co-Pilot	1	Navigator	2
Co-Pilot	3	Waist Gunner	2
Bombardier	3	Unknown	5

Source: U.S. Army, Monthly Intelligence Report, May 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 43.

Baiting

To bait the submarine was to give it the impression that its submerged departure from an attacking plane had been successful.[21] If a submarine was able to escape an aircraft attack by submerging, the aircraft would continue to search the area for not more than fifteen minutes, then depart the area. The aircraft would withdraw from the last known position of the submarine by at least thirty miles for approximately thirty minutes, one hour preferred, then return.[22] The hope was that the submarine would have resurfaced.

Concealment

AAFAC SOP states that submarines were sighting two out of three aircraft and were able to make their escape under the sea before the aircraft arrived on top.[23] To increase the aircraft's odds of arriving unnoticed, the aircrew used cloud coverage and relative positioning. Aircraft flying in and out of cloud bases or above the cloud bases would be provided the concealment needed without a significant loss in the visual search.[24]

Recommended altitudes for patrolling aircraft without radar were between 4,000 to 5,000 feet when the cloud cover ceiling was 5,000 feet or higher. However, when cloud coverage was not greater then five-tenths and cloud tops were below 5,000 feet, the aircraft were to patrol above the clouds.[25]

In January 1943 the AAFAC's Monthly Summary proposed the support of camouflaging aircraft. While no single method of camouflage was considered perfect, painting the underside of the wings and airframe white would tend to reflect the majority of light falling on them. The AAFAC based their proposal on British experiments with antisubmarine aircraft. An uncamouflaged aircraft, flying at 1,000 feet, at 12,000 yards had an 87 percent chance of being spotted by a submarine lookout. However, the same aircraft camouflaged with a white undercarriage would be spotted only 42 percent of the time.[26]

Choke Point

Choke point tactics used by the AAFAC involved land-based aircraft patrolling a common area that the submarine was forced to use. The concept in theory was simple: concentrate a moderate density of ASW aircraft, flying both day and night, on a known submarine operating area. Equate it to fishing in a stocked lake, and the lake used by the AAFAC was the Bay of Biscay. There were two key elements in choosing this area. First, Germany had based the bulk of its Atlantic patrolling U-boats on the west coast of France and therefore transited this bounded area extensively to and from their patrols. Second, the German U-boat could not transit entirely submerged. In a twenty-four hour period the U-boat had to surface to charge its batteries for four hours to continue submerged.[27]

TABLE 5

OPERATION GONDOLA
6-15 FEBUARY 1943

	Inner Gondola	Outer Gondola
Aircraft Hours Flown	1,182	1,078
U-boats Entered	40	38
U-boats Sighted	4	14
U-boats Attacked	1	6

Source: Max Schoenfeld, Stalking the U-boat (Washington and London: Smithsonian Institution Press, 1995), 46.

In 1943, the 1st and 2nd Antisubmarine Squadrons of the AAFAC, which were already deployed to the RAF Coastal Command, used such tactics in the Bay of Biscay

while operating with the British. The campaign was Operation Gondola (table 5) and occurred 6 to 15 February. These dates were chosen to coincide with the expected return of U-boats after two convoy excursions. The area to be patrolled was divided into both an inner and outer region. The British assigned the AAFAC B-24's to work in conjunction with LR aircraft to the outer region.[28] Of the fourteen U-boats sighted in the outer region, the AAFAC B-24's sighted all but two and accounted for all the attacks.

Cueing

The German U-boats, through their command and control system, provided search cueing information to the allies in the form of directional finding (D/F) fixes and position information.[29] Admiral Karl Doenitz, seeking to use his submarines optimally, insisted they radio back to headquarters on a regular basis.[30] These high frequency (HF) transmissions provided the search cueing information used by the allies. The transmitted energy from the submarine's transmission was intercepted from convoy vessels and provided a line of bearing on which a U-boat was located, or if more than one platform received the transmission, a fix of its actual position was possible. The line of bearing or fix information relayed to an ASW aircraft gave it an initial search area to begin its search. By December 1942 the transmissions were also being decrypted on a regular basis by the Allies and provided additional information on the U-boat's intentions. The advance notice of a U-boat attack permitted aircraft to be sent out to reinforce a convoy.[31]

Attack

The attack phase of the ASW prosecution is in itself a duel between the aircraft and the submarine. Both entities were able to maneuver in three dimensions, however in different mediums. Once the submarine was submerged the attack phase all but ended for the AAF aircraft. In the attacks against the U-boats, speed was of the essence. The difference between an attack being made or not was a function of time, many times only a matter of seconds.[32]

AAFAC policy on attacking submarines was to concentrate the effort on those submarines that were on or near the surface.[33] An attack on a submarine that has submerged by more than fifteen seconds proved to be a waste of effort and armament, and showed no signs of success.

The visual confirmation of a submarine as enemy was critical, although not required, before an attack could commence. Within a designated submarine sanctuary, aircraft were not permitted to attack until the submarine was identified as hostile "beyond (any) possibility of doubt."[34] However, outside this sanctuary it was the responsibility of the submarine to establish herself as friendly. Aircraft were permitted to attack without delay.

Positioning

"Try to attack down sun and up moon, " states the AAFAC Standard Operating Procedures (1942).[35] The element of surprise by the aircrew is gained by shielding the aircraft in the blind spots Mother Nature provides. The key to this procedure was the word "try." If the aircrew had the time to set up this tactic, the few seconds achieved by

being masked by the brightness of the sun or the darkness away from the moon would make the difference. On 8 July 1943, a B-24 crew gained radar contact eighteen miles ahead. The pilot masked his approach through the use of cloud coverage and set up for attack with the sun at his back. This first attack was delivered without any response from the U-boat. However, on the second attack run the U-boat put up so much antiaircraft fire that the aircrew was unable to make the delivery of its armament.[36]

On 2 August 1943, a B-24 similarly gained radar contact at twenty miles out. Once again the pilot set up for an attack down sun. This time the U-boat opened fire with light flak while the aircraft was one mile out. Nonetheless, the pilot proceeded with the attack since the firing was inaccurate. The submarine was sunk with this one attack run. The squadron commander of the 4th Antisubmarine Squadron called this an excellent transition from a radar and visual contact into a perfect approach out of the sun.[37] Much of the inability of the submarine to accurately deliver its antiaircraft fire is attributed to the sun.

Killer Hunt

The concept of the killer hunt tactic was in the combined pressure brought on in the search and attack phases by multiple ASW assets, either air or surface.[38] Ironically, it resembled the tactics of the U-boat's wolf packs; when a convoy was sighted the other U-boats would be summoned to converge on the convoy.[39]

On 19 July 1943 an air killer hunt began 200 miles east of Cayenne, French Guiana and succeeded in destroying an enemy submarine over the course of two days.[40] The AAFAC began the hunt on the 19th while the U.S. Navy finished it on the 20th.

The initial contact was made by a B-24D while on convoy escort duty out of Zandery Field, Suriname. The aircraft was able to make two attacks on the submarine but had to break off the assault when heavy antiaircraft fire from the submarine damaged the aircraft such that it became unsafe to handle. Six hours later, a B-18B from the same field was able to regain contact on the submarine thirty-five miles from its earlier position and continue with the attack. Twenty minutes later the submarine dove and escaped until the Navy continued the attack thirty hours later.[41]

Harassing

The AAFAC believed that just the mere presence of having an aircraft out on patrol brought concern to German U-boat commanders. AAFAC's Standard Operating Procedures (SOP) states that "the harassing effect on U-Boat crews is considerable. They are afraid of aircraft and are uneasy in areas where aircraft are known to be operating."[42]

The underlying strategy was to place the aircraft on the offensive instead of the U-boat. If the aircraft could force the U-boat under the water it reduced the U-boat's ability to proceed with an attack. The U-boat's speed and maneuverability were greatly reduced once forced under the water.

Through October 1942, First Bomber Command conducted a total of 139 attacks, yet only one submarine was actually registered as destroyed (fourteen others were in the seriously damaged category).[43] At the same time, the First Bomber Command had flown nearly 120,000 hours on patrols. The attacks were not rendering the U-boats ineffective during this time, but the increase in aircraft patrols was. The

aircraft's presence forced the enemy to submerge and stay down long enough that their targets disappeared.[44] Aircraft just being out on patrol reduced the hunting opportunities available to U-boats.

Equipment

Radar

In March 1942 the AAF began to have a second search sensor aboard its planes besides the human eye: radar. Initially, the total number of planes with radar was only four.[45] Radar allowed detection of an enemy submarine during poor visibility, both day and night. It also expanded the amount of area that could be searched over a given amount of time.

The patrol depicted at the beginning of chapter one illustrates the ASW advantage that radar brought to the aircraft. The U-boat that was attacked and sunk was U506. Her survivors stated that they never saw the B-24 until it was 200 yards from them.[46]

In November 1942 the first two AAFAC squadrons of B-24s equipped with the S-band radar (ten centimeter wavelength) deployed and operated overseas in England. The B-24s were the only aircraft operating from the British Coastal Command that were outfitted with S-band radar.

By late 1942 Germany had developed a countermeasure for the aircraft search radars, the Metox. However, the Metox receiver was built to detect the L-band radar (150 centimeter wavelength); the S-band receiver, Naxos, was issued to the German fleet by the fall of 1943.[47] Although airborne radar was detectable by German submarines,

there was more of an advantage in its use than in not using it. First, aircraft using radar produced more contacts than those that didn't use it. Second, when the search was done at night or in low visibility, the need for the sensor was much more apparent.[48]

Magnetic Anomaly Detector (MAD)

Once a submarine was contacted and forced underwater by an aircraft there was little the aircraft could do. The aircrew could apply baiting tactics, stay overhead and hold down the contact, or call in surface craft to prosecute with sonar. In 1942 MAD was developed in order to allow the aircraft to continue to track the submerged contact. The MAD device could detect and display a change in the magnetic field produced by a submarine when overflown.[49] In February 1943 the Mk IV MAD systems were being installed in the B-18s and had an effective range of 500 feet.[50] For the first time, aircraft of the AAFAC were able to maintain contact with the submarines even though they were submerged.

Conclusion

The U.S. Army Air Forces abruptly began land-based antisubmarine operations for the U.S. Army by piece-mealing together an assortment of aircraft, equipment, and inexperienced personnel and having them search for submarines in the vast Atlantic waters. Within two short years their operations would be transferred back over to the U.S. Navy--but not before a profound affect on antisubmarine warfare had been established.

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[2]U.S. Army, Monthly Intelligence Report: July 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 15.

[3]U. S. Air Force, Office of Air Force History, The Army Air Forces In World War II: Volume One, Plans and Early Operations, January 1939 to August 1942 (Chicago: University of Chicago Press, 1948), 523

[4]Ibid., 524. [5]Ibid., 523

[6]U.S. Army, Monthly Intelligence Report: July 1943, 15.

[7]U.S. Army, Monthly Intelligence Report: August 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 19.

[8]U.S. Army, Monthly Intelligence Summary: November 1942 (New York: Army Air Forces Antisubmarine Command, 1942), 10.

[9]U.S. Army, Monthly Intelligence Report: August 1943, 38.

[10]U. S. Air Force, Office of Air Force History, 535. [11]Ibid., 535.

[12]Max Schoenfeld, Stalking the U-Boat (Washington and London: Smithsonian Institution Press, 1995), 2..

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[14]U. S. Air Force, Office of Air Force History, 524. [15]Ibid., 527.

[16]U.S. Army, Monthly Summary: December 1942 (New York: Army Air Forces Antisubmarine Command, 1942), 27.

[17]U. S. Air Force, Air Historical Group, The Army Air Forces In World War II: Volume Two, Europe: Torch to Pointblank, August 1942 to December 1943 (Chicago: University of Chicago Press, 1949), 379.

[18]U.S. Army, Monthly Summary: December 1942, 28.

[19]U.S. Army, Standard Operating Procedures III-2: Convoy Air Coverage (New York: Army Air Forces Antisubmarine Command, 5 December 1942), 5.

[20]U.S. Army, Monthly Intelligence Report: May 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 19.

[21]U. S. Air Force, Office of Air Force History, 532.

[22]U.S. Army, Standard Operating Procedures III-1: Antisubmarine Manual (New York: Army Air Forces Antisubmarine Command, 23 December 1942), 11.

[23]Ibid., 1. [24]Ibid. [25]Ibid., 2.

[26]U.S. Army, Monthly Summary: January 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 25-7.

[27]Schoenfeld, 45. [28]Ibid., 46. [29]Syrett, 260.

[30]Donald C. Daniel. Anti-Submarine Warfare and Superpower Strategic Stability. (Urbana and Chicago: University of Illinois Press, 1986), 38.

[31]Syrett, 260-1.

[32]U.S. Army, Monthly Summary: January 1943, 25.

[33]U.S. Army, Standard Operating Procedures III-1: Antisubmarine Manual, 1.

[34]Ibid., 3. [35]Ibid., 11. [36]Schoenfeld, 96.

[37]U.S. Army, Monthly Intelligence Report: July 1943, 32-3.

[38]U.S. Army, Monthly Report: October 1942 (New York: Army Air Forces Antisubmarine Command, 1942), 8.

[39]Syrett, 6.

[40]U.S. Army, Monthly Intelligence Report: July 1943, 36. [41]Ibid.,37.

[42]U.S. Army, Standard Operating Procedures III-1: Antisubmarine Manual, 1.

[43]U. S. Air Force, Office of Air Force History, 534. [44]Ibid., 535. [45]Ibid., 527

[46]Schoenfeld, 100.

[47]Charles M. Sternhell and Alan M. Thorndike, Antisubmarine Warfare in World War II (Washington: Operations Evaluation Group, Office of the Chief of Naval Operations, 1946), 154-7.

[48]Ibid., 154-8. [49]Ibid., 31

[50]U.S. Army, Monthly Intelligence Report: February 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 29.

CHAPTER 5

ANALYSIS OF U.S. NAVY ASW AIRCRAFT
THE P-3 ORION

> We want a P-3 on every Russian sub...we don't want them to know we're there, but we want them worrying about it.[1]
>
> Rear Admiral Eric A. McVadon
> Aviation Week & Space Technology

A Brief Overview of the Orion

The U.S. Army, on its way out of the ASW role, transferred seventy-seven of its antisubmarine-equipped B-24 Liberators through July to the end of October 1943 to the U.S. Navy where they were quickly redesignated as PB4Y-1 Liberators.[2] Lockheed's P2V Neptune was the Navy's answer in replacing these war worn B-24's. The P2V was the only "designed-for-the-purpose, land-based patrol plane to see wide, general Navy service" and was introduced in 1946.[3] The early P2Vs were multipurpose aircraft and in 1949 the emerging dash five series Neptunes (P2V-5) would set the new aircraft standard as the best weapon available for ASW. Aside from being equipped with radar, ESM, and MAD, the P2V-5 was the first aircraft to carry both active and passive sonar equipment.[4] The last P2V was delivered to the Navy in 1962.

The initial production version of the P-3 Orion was designated the P3V-1, and the first test model Orion flew on 15 April 1961. After a brief evaluation period, the U.S. Navy ordered 157 P3V-1 aircraft from Lockheed. Deliveries began in August 1962

with Patrol Squadron Eight (VP-8) receiving the first lot of these aircraft replacing all of their P2V-7 aircraft. In November 1962 the U.S. Navy revised and changed all aircraft designations. In the process the P3V-1 was redesignated the P-3A.[5]

Early P-3A aircraft were equipped with a variety of sensors and armaments. Sensor equipment included radar, sonar, identification friend or foe (IFF), electronic support measures (ESM), a diesel exhaust sniffer, a magnetic anomaly detector (MAD), and a powerful searchlight. The typical crew of the P-3A consisted of fourteen personnel, five officers and nine enlisted men: three pilots, two flight engineers, four sensor operators, a tactical coordinator (TACCO), a navigator, a radio operator, an electronic technician, and an ordnanceman.[6]

In 1964 the P-3 was improved and redesignated the P-3B. The P-3B featured improved engines, a modernized sensor suite, and the capability to fire air-to-surface missiles. The diesel exhaust sniffer was not installed on P-3Bs and the sensor operator overseeing its operation was also eliminated from the crew composition.

On 18 September 1968 the P-3C, the model still flown today, entered the U.S. Navy fleet. The P-3C introduced many improved sensor and weapon systems over its predecessors. New additions to it's ASW capabilities were the infrared detection system (IRDS) and the Univac CP-901 digital computer. The IRDS permitted visual searches in near or complete darkness while the digital computer improved the efficiency of the aircraft's tactical crew by reducing many of the manual tasks. With the introduction of the P-3C another of the P-3 Orion's crewmembers was also eliminated from the crew;

the radio operator. The navigator, in addition to his normal navigational duties, would now also assume the duties of the radio operator.[7]

"The forward-deployed, forward-engaged" P-3 force has been the cornerstone of antisubmarine warfare.[8] By the end of the Cold War, twenty-four active operational squadrons made up the P-3 force, twelve on each coast of the United States. To maintain control of the Atlantic region, the twelve east coast squadrons operated out of their home bases in Brunswick, Maine and Jacksonville, Florida, as well as their forward deployed bases of Bermuda; Roosevelt Roads, Puerto Rico; Keflavik, Iceland; Lajes, Azores; and Rota, Spain.[9] Given the P-3's mobility, endurance and aircrew it was able to challenge Soviet submarines daily.

The P-3 Orion has been the backbone of U.S. maritime patrol. It was the Cold War ASW struggle between the United States and the Soviet Union that drove the contest between the P-3 and Soviet submarines. The same year the P-3A entered the fleet, Soviet submarines were entering the U.S.'s playing field operating in the western Atlantic-Caribbean area starting with diesel-electric submarines. In 1969, approximately when the P-3C's were being introduced to the fleet, the Soviets escalated the contest by deploying their Yankee class nuclear ballistic missile submarines in the Atlantic. Throughout the Cold War years the Soviets continued to refine their development of submarines and the P-3 evolved to respond. The P-3 Orion persevered throughout the Cold War.[10]

Aircrew

The primary mission of P-3 aircraft was "detection, localization, surveillance, and attack of targets that pose a potential military threat."[11] Each P-3 crewmember performed a vital and demanding role in support of this mission. In the old adage that the chain is only as strong as its weakest link, each crewmember aboard a P-3 was similarly bonded. Working together as a whole, a seasoned crew could successfully challenge the most competitive submarine. A typical ASW crew, in the last years of the Cold War, was composed of three pilots, a tactical coordinator (TACCO), a navigation/communication (NAV/COMM) officer, two flight engineers (FE), two acoustic operators, a nonacoustic operator, an ordnanceman, and an in-flight technician (IFT).

Within each crew there was a mission commander (MC) responsible for all phases of the assigned mission, except those that relate to the actual safety of the aircraft with respect to flying, which fell under the realm of the pilot.[12] The MC had the most tactical experience aboard the aircraft and was either the patrol plane commander (PPC), the most senior pilot on the crew, or the tactical coordinator, the senior naval flight officer onboard. The MC directed the coordination of the crew and was responsible for the effectiveness of the flight.

While the P-3 was only a dual-piloted aircraft, the three pilots assigned to the crew provided the flexibility to ensure the cockpit crew was attentive and alert. With a normal operational flight averaging approximately nine to ten hours, the demand of maneuvering the aircraft throughout a mission required this flexibility for safety. Aside

from the PPC, the cockpit crew was composed of the 2P and 3P, the second and third pilot respectively. The FE also maintained a seat in the cockpit, between and behind the two pilots controlling the aircraft. During a mission, he would continually monitor the engine and flight station controls and indicators.[13] This three man team in the cockpit allowing "eyes" to scan both in and out of the cockpit.

The TACCO was the focal point of all tactical information derived from the aircrew and their systems. He formulated a course of action for the assigned mission and would continuously scrutinize, review, and revise it as the situation developed.[14] The TACCO, through the MC, determined when and how to use weapons and sonobuoys.

The NAVCOMM was undoubtedly the most task saturated crewman within the crew. As the name implies the NAVCOMM continuously navigated the aircraft and communicated tactically. Throughout the tactical mission, he was responsible for establishing the route to and from the operating area, monitoring the aircraft's position and navigational systems, and maintaining the tactical records of the flight.[15]

Acoustic operators (sensor one and sensor two) were the key to the sounds in the sea, in particular those emanating from a submarine. Together they were responsible for the detection, classification, and reporting of subsurface contact data.[16] The nonacoustic operator (sensor three) would support the mission by using radar, ESM, MAD, and IRDS as directed by the TACCO.[17] Together with MAD, sensor three's equipment allowed him to detect contacts on or below the surface.

The ordnanceman ensured the weapons and sonobuoys were properly loaded and set prior to departing for a mission. While on station, the ordnanceman was responsible

for deploying sonobuoys carried internally within the aircraft as well smoke generators and other stores.

The P-3 crew was also designed to allow less experienced personnel to mature tactically and gain experience through a process of upgrading. With time, experience, and additional qualifications, the sensor two would become a sensor one, the NAVCOMM would become a TACCO, and the pilots would upgrade from a 3P to a 2P and ultimately become a PPC. Through this nurturing process, crewmen were able to gain valuable tactical experience while still providing service to the crew. Overall, the ultimate gain for the crew was in each crewmember possessing a thorough knowledge of equipment and responsibility used primarily by him plus familiarity with the other crewmember's equipment and responsibility.[18]

Integrity of the crew formed the bond that permitted the crew to begin to work together more efficiently and effectively. However, due to personnel rotational requirements in and out of the squadrons, the crew changes were more rapid than squadron commanders would have liked.[16] A crew that was able to stay together longer found itself melding into one unit rather than a group of individual crewmen. This being so, every effort was made to keep the operational nucleus of the crew (PPC, TACCO, sensor one, and sensor three) together in training as well as on operational missions.[19]

The limiting factor on any mission was crew fatigue. Sensor operators were required to maintain a high level of concentration while continually observing their equipment for that brief moment of contact with the submarine or maintaining contact throughout the onstation period. The routine ASW mission lasted nine to ten hours

which included transit time to and from the operating area. While the P-3 was capable of twelve hours flights, the preferred tactic was to cycle a new aircraft and crew to continue the prosecution rather than extending the onstation time.[20]

ASW Prosecution

In general the P-3 antisubmarine process entailed five phases: detection, classification, localization, tracking, and attack. Some venture to say a sixth phase actually existed, reattack. Nonetheless, in every ASW mission the detection phase was always the origin of the prosecution. In a visual search the process may proceed directly from the detection phase to the attack phase, whereas an passive acoustic search will attempt to proceed through each phase sequentially.[21]

Detection

Before a submarine could be attacked it obviously had to be detected, which is to say that "something has been observed which may be a submarine"[22] The detection may have occurred in one of two methods. First, the submarine may have transferred some energy to the searcher, such as emitting its radar, or noise in the water. Second, the submarine may have disturbed a natural field, such as the earth's magnetic field.[23] In either method, detection only occurs once. Any further analysis concerning the presence of an object fell under the classification phase.

Detection may have been an audible sound pattern recognized by the acoustic operators, a return from sensor three's radar, or a visual sighting of the wake of a periscope by one of the pilots. The probability of detecting an item of interest had

numerous parameters which needed to be sorted out by the aircrew. However, despite the equipment and tactics used, detection was most influenced by the aircrew's training, alertness, and fatigue.[24]

Classification

Classification curtailed identifying those contacts detected as either a submarine or non-submarine. Within the submarine contacts, the contacts are classified based on the judgment of the aircrew as CERTSUB, where there is no doubt that the contact is certainly a submarine, i.e. a visual authenticated sighting; PROBSUB, that there is strong indication that the contact is probably a submarine; or POSSUB, it may possibly be a submarine because of the characteristics it is showing. This important classification call made by the aircrew was vital to ensure precious ASW time was not wasted on trifling contacts or that a submarine would not pass through their search undetected.[25]

Localization

The localization phase of the prosecution attempted to attain an accurate position of a submarine contact. Acoustically, localizing a contact was accomplished by a cross-bearing fix from passive sonobuoys, or a range and bearing fix from an active sonobuoy. A contact may have also been localized by detecting a MAD confirmation. Localization prepared the aircrew for the tracking phase.[26]

Tracking

Tracking a submarine was equivalent to grabbing a bull by the horns and not letting go. The submarine had control of its movement through the water, while the

aircraft and aircrew continuously converted its sensor contact information into an estimate of the target's position, depth, course, and speed. Tracking was the "generation of an estimate of a submarine's past and future movement that enabled a fire control solution to be worked out."[27] Tracking did not necessarily mean that contact with the submarine had to be continuous; it could be intermittent as long as the contact could be reaquired in a predicted period.[28]

Attack

The final phase of the ASW prosecution was in placing a weapon, within its lethal radius, on the submarine. The weapon chosen would determine the accuracy and timing needed for its placement. From the time the weapon was released until the time it exploded, there was time that had to be accounted for as it transited through the air as well as the water. It was during this transitional time that the target could alter its course, speed, and/or depth. This was the scenario that lead to the reattack phase. Always akin to Murphy's Law and knowing that a weapon in the water would inevitably change the submarine's current course and speed, the aircraft and aircrew would immediately set up for a reattack.[29]

Acoustic

The "modern" Soviet diesel submarine with its improved engines, generators, and batteries permit it to remain submerged for extended periods of time. The nuclear submarine on the other hand has virtually no limit on its time submerged. Through the years the P-3 had relied on the sound waves emitted by the submarine during the

submarine's underwater periods. With a primary mission of detecting, classifying, locating, tracking and, when necessary, attacking unfriendly submarines, the primary sensor for a submerged submarine becomes the acoustic sensor.[30] Acoustic pressure waves permitted the transmission of the sound of the submarine through the sea at distances which were operationally significant and exploitable.[31]

The P-3 acoustic operators were the critical link between the equipment and the information provided. These highly trained professionals knew the difference between a submarine signature and other underwater noises. While their equipment was able to monitor the frequencies in the ocean, they would assess the information to determine if indeed a submarine was present. The submerged submarine generally had more than a dozen detectable physical signatures.[32] The operators analyzing these signatures were be able to determine its country of origin, class of submarine, course, speed, and depth.[33]

There were several sources for the noise radiation that emanated from the submarine, which may or may not have been prevalent depending on the speed and depth of the submarine. These sources included hull vibration, propellers, and power plant equipment. The aggregate of the discrete (linear-frequency) lines produced by many of these sources made up the footprint unique to each submarine. "The discrete components are the most visible signs of the submarines' source level spectrum since they are detected even at low speed, when submarines produce minimal noise."[34]

The rotation of the propellers produced discrete lines in the lower frequency band.[35] The noise produced by this rotation could be carried great distances, up to

several thousand kilometers, since sound absorption at these low frequencies was not markedly absorbed by the ocean waters.[36]

With the sonobuoys deployed in the water, the most persistent problem encountered was to maintain an accurate relative position between the aircraft and the sonobuoys, or plot stabilization (Plot Stab). Once deployed in the water sonobuoys would begin to drift due to winds, sea state, and ocean currents. The P-3 used a separate navigation mode, tactical navigation (TACNAV), with its onboard computer to assist in this problem. When the TACNAV mode was entered the aircraft's tactical position was maintained relative to a reference point in the water, usually a sonobuoy. The aircrew had to be able to position the aircraft relative to its sonobuoys with a high degree of accuracy to be successful during any phase on any mission.[37]

Sonobuoys

Sonobuoys were the link from a subsurface contact to the P-3. Sonobuoy information was used to determine the tactics employed by the P-3 throughout the prosecution of a target submarine. A P-3 deployed passive sonobuoys during all phases of the prosecution in an effort to gain initial contact, localize, classify, track, and attack the target. The sonobuoys used by the P-3 were powered by either a seawater activated battery or a lithium battery and operated a radio transmitter which enabled the sounds of the sea to be carried to the aircraft's acoustic processor. The data was transmitted on a preset VHF channel (RF channel). The P-3 was capable of carrying a mix of eighty-four sonobuoys, forty-eight external and thirty-six internal.[38] The external sonobuoys were preset before takeoff and could not be reprogrammed once airborne (table 6).

TABLE 6

P-3 TYPICAL BUOY TYPES

Sonobuoy	Hydrophone Depth (ft)	Life	RF Channels
DIFAR (AN/SSQ-53B)	90, 400 or 1,000	1, 3, or 8 hrs.	1 thru 99
DICASS (AN/SSQ-62B)	90, 400 or 1,500	30 minutes	31 Preset

Source: NAVAIR 01-75PAC-1.1, NFO/Aircrew NATOPS Flight Manual: Navy Model P-3C Aircraft (Washington, DC: Department of the Navy, 1 December 1992), I-4-14.

The most common type of passive sonobuoy used by the P-3 was the Directional Low Frequency Analysis and Recording (DIFAR) sonobuoy, in particular the AN/SSQ-53. DIFAR buoys detected directional information and frequencies emanating from the submarine and transmitted it to the acoustic operator's equipment for analysis.[39]

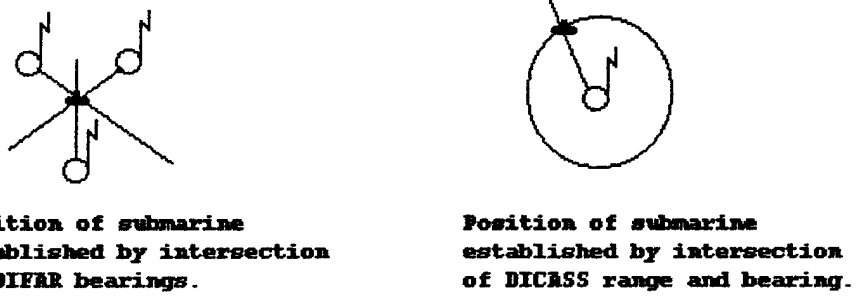

Figure 5. Acoustic Positioning Using DIFAR and DICASS Sonobuoys. Source: J. R. Hill, Anti-Submarine Warfare, 2d ed. (Annapolis, MD: Naval Institute Press, 1989), 48-49.

Directional Command Activated Sonobuoy System (DICASS) sonobuoys provided the aircraft with both a range and a bearing to the submarine (figure 5). Active sonobuoys, such as DICASS, were normally used during the attack phase of a prosecution.[40] The DICASS sonobuoy deployed from the aircraft would remain silent until it received a command from the acoustic operator to radiate a sound pulse. The reflected signal from the submarine provided the information for range and bearing.[41]

Prosecution

From the perspective of a P-3, a Soviet submarine operating in the Atlantic was always a threat. But what kind of threat? The threat, once determined, would dictate the parameters upon which the prosecution would follow. While the antisubmarine warfare techniques used may appear to be the same for every submarine, they actually responded to the purpose of the submarine. The ballistic submarine had a strategic purpose, to deliver its nuclear weapons against the United States. An attack submarine had a tactical purpose, to approach a given target undetected and destroy it. The guided missile submarine also operated with a tactical purpose, but did so from a greater distance.[42]

Cueing

Once the P-3 found a submarine, P-3's could maintain contact by handing off the prosecution to a relieving aircraft, preferably another P-3, and continue to repeat the cycle. However, having the best land-based ASW platform was of little value if the P-3 Orion had to search the entire ocean region without a starting point or some sort of

cueing to begin the search. Two types of initial cueing systems used by the P-3 were the Navy's Underwater Sound Surveillance System (SOSUS) and Surveillance Towed Array Sensor System (SURTASS).[43]

SOSUS was a vast network of undersea hydrophones connected to shore stations, enabling submarines to be heard. The first hydrophone was laid in 1954, and for years it has been one of the Navy's best kept secrets and has been described as "the "backbone" or "primary method" of U.S. ASW search."[44] The sound waves emanating from a submarine's engines and propellers were able to be heard and tracked by technicians working ashore.[45] Aside from detecting the submarine's signatures, SOSUS could triangulate and localize a submarine to an accuracy which under the best of circumstances might be in the range of some tens of kilometers."[46]

SURTASS was deployed from dedicated surface ships and could extend hundreds of meters behind the vessel. The sensors were embedded within towed cable and were able to collect the passive acoustic information "similar to the SOSUS arrays."[47]

These cueing systems enabled the P-3 to reduce its initial search area tremendously. Acoustically, the P-3 was better able to deploy a sonobuoy search pattern in an attempt to localize the cued information. Nonacoustically, the TACCO would combine the other sensors available efficiently to maximize their use based on the mission or the environment.

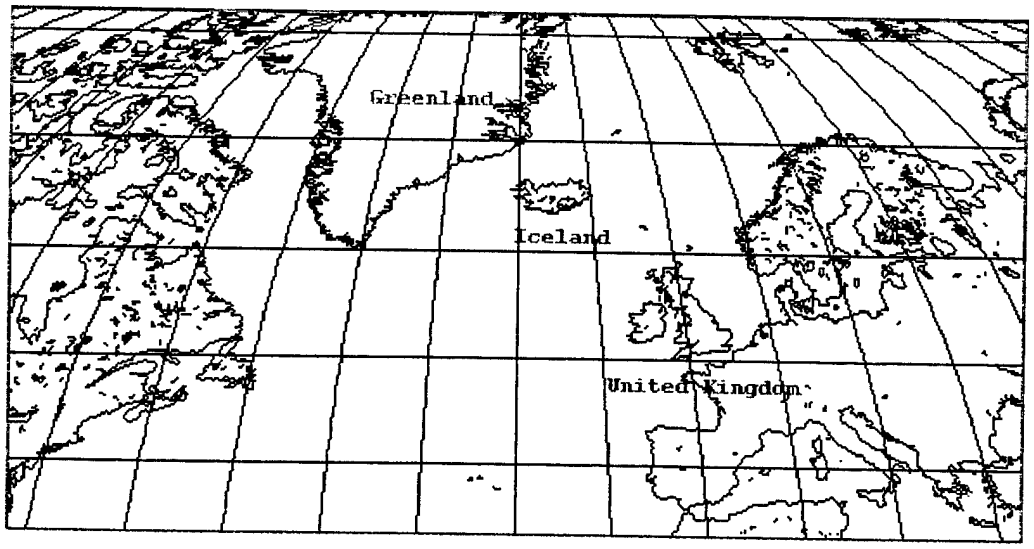

Figure 6: The Greenland-Iceland-United Kingdom (G-I-UK) gap.

Choke Points

Most Soviet submarines had to sail through relatively narrow choke points to deploy to either the Atlantic or Mediterranean. Since the main elements of the Soviet's submarine force were located in the Northern Fleet, these submarines, based in northwest Russia, had to sail through the gap between Iceland and either the United Kingdom or Greenland. This is otherwise known as the Greenland-Iceland-United Kingdom (GIUK) gap.[48] The GIUK gap provided a natural geographic barrier for the early detection of Soviet submarines.[49] Primarily the nuclear-powered ballistic missile submarine remained north, in particular in the Barents and Kara Seas. However, these submarines along with the attack submarines, both nuclear and diesel-powered, were continued to run this natural gantlet. The diesel-powered submarines enroute to and

from the Mediterranean, while the nuclear-powered submarines were enroute to both the Mediterranean and the Atlantic.[50]

Independent, ASW Inner Zone and Outer Zone

The ASW Inner and Outer Zones were referenced from a submarine's high value target, such as an aircraft carrier within a carrier battlegroup. With the advent of the long range surface missiles carrier by the guided missile submarines the U.S. Navy developed these two zones. The outer boundary of the ASW Inner Zone was placed at the fifty mile range, or first convergence zone. The ASW Outer Zone extended to more than 150 miles. The concept in the zones was that the submarines would be detected and destroyed while in the outer zone. Those submarines that did penetrate the inner zone would sacrifice their possibility of being detected in return for targeting data.[51]

The Outer Zone was conducive to the passive search, and encompassed more than 250,000 square miles of ocean thus the submarine had plenty of room to manuever as well as time to set up its approach. Conversely, the Inner Zone consisted of 8,000 square miles and the submarine had to be ever vigilant of being detected while best positioning itself for a strike. Within the Inner Zone the passive search would still be maintained, however, active methods were the primary means of detection.[52]

Independent ASW operations were the cornerstone of the P-3. Operating thousands of miles from their homebase, without support, in all types of weather the P-3 was in pursuit of its primary mission of anti-SSBN operations.[53] Miles away from support, the aircrew answered to themselves on the prosecution of the submarine. Once contact was made, a P-3 would maintain contact for the duration of its onstation period

then turn over its prosecution to another P-3, then depart. Ideally the cycle repeated itself until the submarine returned to its homeport.

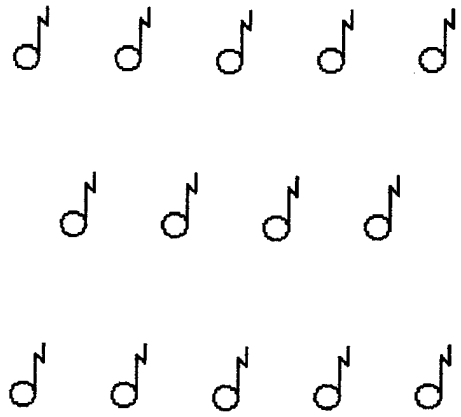

Figure 7. Hypothetical Passive Sonobuoy Search Pattern.

Sonobuoy Search Pattern

Whether working independent or in conjuction with another ASW asset, the strength of the P-3 was in its ability to lay a large sonobuoy search pattern just about anywhere, and monitor it. The acoustic operators in P-3Cs, depending on their acoustic equipment, were able to monitor up to sixteen or thirty-two passive sonobuoys within a sonobuoy search pattern.[54] The actual size and shape of the search patterns were dependent on inputs such as probability of detection, acoustic signature and strength of the submarine, location, tactics, and time of last contact. "In planning a search, the nature of the target is usually known and its general position and intended movements may be more or less known."[55]

A P-3's sonobuoy search pattern was successful if it generated the initial detection of the submarine. The number of sonobuoys used and their pattern of deployment after initial detection were dependent on the subsequent phases of the prosecution, such as localization and tracking, as well as the quietness of the submarine.

Equipment

Acoustic

By the end of the Cold War the P-3 was using two different acoustic processors, the AQA-7 or the UYS-1 or Single Advanced Signal Processor (SASP). The AQA-7 was the predecessor to SASP. Upgraded through the years, the AQA-7 was introduced in 1969 and was the premier acoustic processor for many years. The AQA-7 processed and refined the signals from the sonobuoys so they could be analyzed and classified for the purpose of locating submarines. Information was recorded and displayed on paper charts (grams) and was also able to be heard through the operators' headsets. The system is actually two independent systems each monitored and controlled by one of the two acoustic sensor operators.[56]

In 1985 SASP began to emerge into the fleet in the upgraded P-3C Update III aircraft.[57] Unlike the AQA-7, the SASP acoustic system worked as a single system controlled by both sensor operators. Aside from its many advancements in processing acoustic information, the key improvement SASP brought to the P-3 was its ability to monitor twice as many passive sonobuoys as its predecessor. While the AQA-7 was only able to process a maximum of sixteen buoys (eight by each operator), SASP permitted the processing of thirty-two.[58]

MAD

While MAD was not a long range detection sensor, it did provide contact information, aside from acoustic, on a submerged submarine. Since the submarine was made of ferrous metal, it disturbed the local earth's magnetic field. It was this change that was detectable by the P-3's MAD system. The slant range distance the disturbance in the magnetic field could be detected had been noted to range from several hundred feet,[59] to the order of 500 meters from the sensor.[60] Due to the relatively short ranges, MAD was generally not used as a primary search sensor. For the same reason, however, it was beneficial in the localization, tracking, and attack phases.

Radar

Two radars, located in the aircraft nose and tail section, provided the P-3 with 360-degree azimuth coverage. It was believed that the submarine would verify its acoustic targeting solution during an attack run. The deterrent for this practice was to cover the area with airborne radar.[61] While the periscope may not necessarily have been seen by the radar, the submarine would not dare risk its exposure for fear of being detected and settle for being forced into a blind shot.

Visual

Although nearly every piece of ASW equipment onboard the P-3 had been modified since the first P-3 rolled into the fleet, one ASW item had remained the same--the human eye. Visual sighting is the oldest, yet most positive way of identifying a submarine. The submarine, in many tactical situations, preferred and/or demanded a

visual sighting itself for its targeting solution. The potential for either a periscope or periscope wake always existed on any ASW mission and the P-3 due to its height above the ocean surface gave it an added advantage over its surface counterparts.[62]

The visual search for a submarine was not limited to daytime hours. Night detection was also possible and bioluminescence was only one example. As a submerged submarine moved through the water certain species of plankton (dinoflagellate) would emit a blue-green light when disturbed by the ship's hull and turbulent wake. This condition was not always present and could not be relied upon. It required a relatively shallow operating target, a darkened or moonless night, water where there was a steep temperature gradient, and of course the bioluminescent plankton.[63] When the condition did exist, the underwater "spotlight" was a beacon in the night.

IRDS

Infrared detection both complemented and expanded the visual search process onboard the P-3 during either day or night. IRDS was a passive system that was operated by the nonacoustic operator, sensor three, but with certain restrictions could also be operated by the TACCO. Both the sensor three and TACCO had video displays at their stations. The IRDS receiver was located in the lower portion of the nose of the aircraft and extended into the airstream when operating. It had full 360-degree coverage and scanned the ocean surface either manually or computer assisted. The range for infrared detection was dependent upon size of the target and the amount of infrared

received by the system. Dry and cold conditions provided the best environment for infrared detection.[64]

Conclusion

In 1986 the United States, with the consent of its Allies, adopted the Maritime Strategy in order to bring naval forces to bear in the case of a Soviet-American confrontation. This strategy emphasized deterrence, seizing the initiative, and carrying the fight to the enemy. With respect to ASW, the strategy stated that "It will be essential to conduct forward operations with attack submarines, as well as to establish barriers at key world chokepoints using maritime patrol aircraft [P-3's], mines, attack submarines, or sonobuoys, to prevent leakage of enemy forces to the open ocean where the Western Alliances's resupply lines can be threatened."[65]For the P-3 Orion, this strategy had already been begun twenty-four years earlier.

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[12]Ibid., IX-13-1. [13]Ibid., IX-13-3. [14]Ibid. [15]Ibid., IX-13-4. [16]Ibid. [17]Ibid.

[18]Ibid., IX-13-1.

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[33]Blay, 43.

[34]E.V. Miasnikov, "What Is Known About the Character Of Noise Created By Submarines?" [Online] Available http://www.fas.org/spp/eprint/snf)3221.htm, January 22, 1998.

[35]Ibid. [36]Ibid.

[37]Wayne Cradduck, ed. Orion Service Digest: Issue 37 (Burbank, California: Lockheed-California Company, October 1979), 5.

[38]U.S. Navy, NAVAIR 01-75PAC-1.1: NFO/Aircrew NATOPS Flight Manual: Navy Model P-3C Aircraft, VIII-12-201.

[39]Blay, 7. [40]Hill, 81. [41]Blay, 7.

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[62]"Underwater Detection and Tracking Systems." [Online] Available United States Naval Academy Homepage http://web.wse.nadn.navy.mil/wse/academic/courses/es300/book/CHAPTER9.htm, February 18, 1998.

[63]Ibid.

[64]U.S. Navy, NAVAIR 01-75PAC-1.1: NFO/Aircrew NATOPS Flight Manual: Navy Model P-3C Aircraft, VIII-12-333 to 335.

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CHAPTER 6

SUMMARY AND CONCLUSIONS

> There is no guarantee that the antisubmarine measures successful in the past will continue to be adequate in the future.[1]
>
> Charles M. Sternhell and Alan M. Thorndike
> Antisubmarine Warfare in World War II, 1946

Summary

This study was conducted to investigate whether there are any lessons that could be learned from land-based ASW operations in the Atlantic by comparing those of the U.S. Army during World War II with the P-3 Orion of the U.S. Navy during the Cold War. The most effective method of determining the answer to the research question was to establish the historical evidence of baseline aircraft used and examine the interrelationship of aircraft, ASW equipment, and tactical employment capabilities by comparative process. In this manner, standard measures of effectiveness, or success, could be established based on four of the nine principles of war (surprise, maneuver, offensive and objective) to define the answers to the conceptual inquiries.

Conclusions

What lessons can be learned from the land-based ASW operations in the Atlantic by comparing those of the U.S. Army during World War II with the P-3 Orion of the U.S. Navy during the Cold War?

The overarching lesson learned from this study is that there lies a significant need in pursuing and continuing the capabilities of a land-based ASW aircraft. The tactical significance of land-based ASW aircraft does not reveal itself in the number of submarines it had sunk during these two wars, but rather in its ability to keep the threat from unleashing its potential firepower. In the ten month existence of the Army Air Forces Antisubmarine Command, U.S. Army aircraft flew 142,842 hours but were only attributed to having "sunk" or "probably sunk" ten enemy U-boats. Noteworthy is that the units attributed to these sinkings were forward deployed aircraft operating out of England.[2] In retrospect, the number of Soviet submarines "sunk" by the P-3 Orion during the entire Cold War--zero.

Land-based ASW aircraft played an integral part in both wars namely because of the large numbers of submarines patrolling in or around the Atlantic. In the post Cold War environment it may be difficult to justify their existence when the threat may be a few diesel electric submarines owned by a country such as Iran. As in World War II it may be enough to have a long-range land-based aircraft available that is able to quickly join in the ASW operations when and if needed.

Chapter 2 showed a photo of the Army Air Forces' B-24D Liberator and referred to it at the best weapon available in World War II for the purpose of antisubmarine warfare. After fifty years its basic attributes are still seen in the P-3 Orion and are as essential today as they were in both wars: a long-range capability, a crew of eight to twelve ASW specialists, and the ability to operate from foreign bases in order to extend their coverage of the seas. By the end of the AAFAC's brief existence, the B-24D

would still only be equipped with radar as additional search sensor over the crewmember's visual scan. Given a short amount of time the B-24D was destined to carry more equipment indicative of the P-3 in the Cold War. In February of 1943 MAD was being tested and installed on the AAFAC's B-18s and in their Monthly Summary: January 1943 a new technical device called the expendable radio sono-buoy was gaining acceptance.[3] The basic attributes of these aircraft have withstood the test of time, where as the equipment and tactics are revised, updated, developed, and upgraded on a continuous basis.

Since World War II, the cat-and-mouse technology advances by both the submarine and the land-based ASW aircraft have "stirred a debate on the future direction of antisubmarine warfare."[4] The German U-boat at the end of World War II set the stage for the next generations of submarines; submarines which reduced the chance of being detected by remaining submerged for extended periods of time. With the collapse of the Soviet Union the stage was once again set for the next generations of submarines. The Soviet's latest generation of submarines, both nuclear and conventional, reduced the chance of being detected by reducing their "noise" level substantially. The fourth generation of nuclear powered submarines was launched in 1995, the Severodvinsk class. "This submarine is even more silent running than those of the Akula class," which came into operation at the end of the Cold War in 1990 and has been considered by American experts "to be the most advanced nuclear-powered submarine in the world.[5]

The Principles

Objective

The overarching objective for land-based ASW operations in both wars was quite simple: keep the enemy submarines operating in the Atlantic at bay. In World War II this meant protecting shipping and safeguarding the oceanic lines of communication in the Atlantic.[6] During the Cold War it meant conducting forward operations "to prevent leakage of enemy forces to the open ocean where the Western Alliance's resupply lines" could be imperiled.[7] However, the objective for post Cold War land-based ASW operations is not as simple. The enemy submarine in this post Cold War time may desire to be kept at bay, operating in or near littoral waters close to its home.[8]

During both World War II and the Cold War, land-based ASW aircraft had a clear mandate to keep the Atlantic sea lanes open between Europe and the United States. In World War II this was done by escorting merchant vessels in convoy and operating independently in search of German U-boats. In the Cold War the antisubmarine patrols of the P-3 were much the same. Independent operations against Soviet submarines were the strength of the Orion, however it also had a convoy escort role with the U.S. battlegroup and its aircraft carrier at the center of attention.

In both wars, the ability to counter submarines quickly and efficiently was fundamental to establishing sea control and maintaining the sea lines of communications in the Atlantic. Land-based ASW aircraft of both wars, with an operating radius of more than 1,000 miles, were able to eliminate gaps in the Atlantic where submarines were able to operate without fear of air interdiction. Without an air threat, submarines were able

to detect and react to any other form of ASW with time in their favor. For example, an ASW ship traveling at twenty knots, twenty miles away from a submarine would take one hour to close that distance. Conversely, an ASW aircraft traveling at 200 knots would take only six minutes to cover the same distance. The mere presence of an ASW aircraft in the vicinity of a submarine meant the ability to react quickly to oppose the threat.

Maneuver

If maneuver is the dexterity to stay ahead of the enemy decisively, to gain and exploit the initiative, then the lesson learned is that the submarine initially gets the upper hand over land-based ASW aircraft. In the ultimate game of hide-and-seek, the submarine picks the playing field and determines how the game will be played. Both forces are able to maneuver in three dimensions, however once submerged the submarine is able to best exploit its dimensions whereas the aircraft is somewhat limited. In World War II, once the U-boat submerged the aircraft had few options: bait the submarine, start a holddown, establish a killer hunt, or reestablish a new search. The submarine, at least for the time being, was safe from being attacked. In the Cold War the submerged submarine was the norm rather than the exception. Acoustic detecting and tracking became the integral part of land-based ASW.

If the submarine had the upper hand by being able to pick the playing field then the lesson was to find and strike him before he arrived in the playing field. Choke points in both wars permitted this to happen. Choke points guaranteed an area where a submarine must be at some point in its deployment. To enter the Atlantic from the

enter; for a U-boat returning from its deployment in the Atlantic the Bay of Biscay was the door to enter. Normally any ASW tactician will say, "there are no guarantees in ASW," however a choke point does provide the land-based ASW aircraft an area to exploit.

Land-based aircraft in both wars seized the initiative to ultimately set up for an attack. For a B-24 in World War II, the aircraft maneuvered so it would catch the U-boat on or near the surface. It was a matter of seconds for the aircraft to make it to the U-boat before the U-boat submerged. Whether this was done by positioning itself with respect to the moon or the sun, or by exploiting cloud coverage, the aircraft tried to position itself such that it could be over the target no later than fifteen seconds after the submarine went under. An attack was always the ultimate goal, at least for the aircrew. For the P-3 during the Cold War the attack potential always existed but was never authorized. Deterrence was the ultimate goal. Therefore maneuvering the aircraft to establish and maintain acoustic contact with the submarine became the challenge. It was not enough to manuever the aircraft for the one attack run like the B-24; the P-3 maneuvered constantly during its entire onstation period with every run having the potential of being an attack run.

Offensive

The submarine, whether diesel or nuclear, always has and always will pick the place and time of its attack. It has always been primarily an offensive weapon. It strived for the opportunity to take the first shot. In World War II a submerged submarine's presence was often not realized until after it made its attack. The strickened ship served

as a "flaming datum", a starting place to transition from the search phase to the localization phase.[9] The flaming datum scenario had a much higher consequence had it occurred in the Cold War when instead of a torpedo, as the first shot fired by a submarine had the potential to be a ballistic missile or nuclear torpedo.

The lesson learned for land-based ASW aircraft was that like the submarine: it also strived for the first shot opportunity. Since the Army Air Forces Antisubmarine Command was first activated, land-based ASW aircraft forged ahead offensively locating submarines before the U-boat could take that first shot. The mere presence of an aircraft operating in the submarine's domain placed the submarine in the position of deciding to attack and risk being attacked.

Another lesson learned was that land-based ASW gave offensive flexibility to the military. Operating out of foreign bases in both wars, ASW aircraft were able to provide an offensive presence in the Atlantic in a matter of minutes or hours. Rotating and relieving aircraft onstation, land-based ASW aircraft were able to provide the endurance needed to continuously monitor an area.

Surprise

The lesson learned here was that while the element of surprise may be a key element in antisubmarine warfare, it does not take long for the opposing force to overcome it. Looking at one ASW piece of equipment used by land-based ASW aircraft, the radar, this point is a little clearer. During World War II land-based aircraft began the war and their searches with nothing more than the crew's eyes to produce contact. Submarines soon began submerging during the day and surfacing at night. Within a few

months land-based aircraft were flying with L-band radar. Within six months submarines had radar detection units installed. Eight months after L-band radars were first used, land-based aircraft began using S-band radar. By the fall of 1943 S-band radar detection units were installed on submarines.

The example above illustrates the point that the element of surprise in land-based ASW is a dynamic, ever-changing factor. Every piece of ASW equipment or tactic used by land-based aircraft was only as effective as the opposing force allowed it to be. Over time, the equipment or tactic would still work, it would just lose some of its effectiveness in the element of surprise. Radar, MAD, and sonobuoys are all effective ASW instruments that have been around for many years and have seen numerous modifications to enhance or regain their element of surprise.

Operations in World War II and the Cold War proved that land-based ASW is an exceptionally complex skill that wastes away all too easily if not constantly practiced and continuously supplemented by training. Just as important is the need to continuously improve airborne sensors to keep pace with the advances made in each new generation of submarines. Acoustically, the submarines of today have reduced their noise level by two-thirds of what they were ten years ago.[10] For the P-3 this means that sonobuoys have seconds worth of contact time vice minutes. Fifty-five years ago acoustic contact was not yet even an option for the Army's B-24. The edge in the element of surprise the ASW aircraft possesses reduces over time with evolving advances in the submarines unless it also evolves.

Closing

This thesis does not present the notion that land-based ASW aircraft are the panacea to the antisubmarine warfare effort, but rather that they are an important supplement. The ASW effort against submarines in the Atlantic during both wars is truly an incomplete picture when looking at individual pieces of the puzzle such as land-based ASW operations. The complete coordination of all antisubmarine forces is what makes the pieces fit together.

ASW in the years ahead may not be the Navy's number one priority anymore as Chief of Naval Operations Admiral Frank Kelso hinted in 1991.[11] However, given the fact that an opposing submarine is out there, be it the Atlantic or littoral waters, ASW forces may disbelieve this statement. The author will always remember Captain Charles H. Wilbur's article and battle cry, "Remember the *San Luis*!" how one submarine wreaking havoc can quickly make ASW job number one once again.[12]

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APPENDIX A

ARMY AIR FORCES ANTISUBMARINE COMMAND OPERATING AREAS
AUGUST 1943

	Aircraft Type and Number			
Operating Area	VLR	LR	MR	SR
Greenland	0	0	8	0
Newfoundland and Nova Scotia	12	0	0	0
Eastern Sea Frontier	20	0	34	0
Gulf Sea Frontier	19	0	15	0
Puerto Rico Sector	0	0	6	0
Trinidad Sector	5	0	21	6
Curacao-Aruba Sector	4	0	6	25
Ascension Island	1	0	6	14
Moroccan Sea Frontier and Gibraltar	24	0	0	0
United Kingdom	48	0	0	0
Total	133	0	96	45

(VLR)-Very Long Range (LR)- Long Range (MR)-Medium Range (SR)-Short Range

Source: U.S. Army, Monthly Intelligence Report, August 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 19.

APPENDIX B

ARMY AIR FORCES ANTISUBMARINE COMMAND COMPOSITION AUGUST 1943

25th Antisubmarine Wing
- 3rd Antisubmarine Squadron
- 5th Antisubmarine Squadron
- 11th Antisubmarine Squadron
- 12th Antisubmarine Squadron
- 13th Antisubmarine Squadron
- 14th Antisubmarine Squadron
- 16th Antisubmarine Squadron
- 20th Antisubmarine Squadron
- 22nd Antisubmarine Squadron
- 24th Antisubmarine Squadron

26th Antisubmarine Wing
- 7th Antisubmarine Squadron
- 8th Antisubmarine Squadron
- 9th Antisubmarine Squadron
- 10th Antisubmarine Squadron
- 15th Antisubmarine Squadron
- 17th Antisubmarine Squadron
- 21st Antisubmarine Squadron
- 23rd Antisubmarine Squadron
- 25th Antisubmarine Squadron

479th Antisubmarine Group
- 4th Antisubmarine Squadron
- 19th Antisubmarine Squadron

480th Antisubmarine Group
- 1st Antisubmarine Squadron
- 2nd Antisubmarine Squadron

Operational Training Unit (OTU)
- 18th Antisubmarine Squadron

Source: U.S. Army, Monthly Intelligence Report, July 1943 (New York: Army Air Forces Antisubmarine Command, 1943), 40.

APPENDIX C

SOVIET NUCLEAR-POWERED SUBMARINES

First Generation (1955 - 1964)

- Hotel Class
- Echo Class
- November Class

Second Generation (1964 - 1974)

- Yankee Class
- Delta Class
- Charlie Class
- Victor Class

Third Generation (1977 - ????)

- Typhoon Class
- Oscar Class
- Sierra Class
- Akula Class

Forth Generation (1993 - ????)

- Severodvinsk Class

Source: Nilsen, Thomas, Igor Kudrik and Alexandr Nikitin. "The Russian Northern Fleet Nuclear-Powered Vessels." Bellona Report Number 2:96. [Online] Available http://www.bellona.no/e/russia/nfl/nfl2-1.htm, January 22, 1998.

APPENDIX D

ACTIVE DUTY P-3 SQUADRONS
(EAST COAST)

Atlantic

Pre-Cold War	Post Cold War
NAS Jacksonville, FL	NAS Jacksonville, FL
VP-5	VP-5 Mad Foxes
VP-16	VP-16 War Eagles
VP-24	VP-45 Pelicans
VP-45	VP-30 The Pro's Nest
VP-49	
VP-56	
VP-30 (FRS)	
NAS Brunswick, ME	NAS Brunswick, ME
VP-8	VP-8 Tigers
VP-10	VP-10 Red Lancers
VP-11	VP-26 Tridents
VP-23	
VP-26	
VP-44	

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