Mastering the Patrol: a Look at the Importance of Training For American Pilots in the Battle of the Atlantic

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Mastering the Patrol:
A Look at the Importance of Training for American Pilots in the Battle of the Atlantic

by
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Presented in Partial Fulfillment of the
Requirements of Senior Independent Study

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LIST OF ABBREVIATIONS

AAF – Army Air Force
AAFAC – Army Air Force Antisubmarine Command
ASW- Anti-Submarine Warfare
ASWORG – Antisubmarine Warfare Operations Research Group
CAP – Civil Air Patrol
CominCh – Commander in Charge United States Fleet
NDRC – National Defense Research Committee
RAF – Royal Air Force
SADU – Search and Attack Development Unit
VPB – Patrol Bombing
Acknowledgments

After having the privilege of researching and studying a topic that I found interesting, I wanted to devote this page in order to state my thanks to everyone who helped me in this project. Everyone that I will mention has assisted me in some way and for that I am grateful.

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INTRODUCTION

In January 1942, with the United States reeling from the Japanese attack at Pearl Harbor, the German Navy struck at the heart of American vessels. While the Japanese forces challenged the might of the American military in the Pacific, the Germans focused on economically strangling the Allies by sinking their merchant ships in the Atlantic. The struggle to command the Atlantic pushed the Axis and Allied powers into an ever-evolving game of cat and mouse, where German submersibles stalked and later fled from the American forces. This took both the Allies and Axis forces all across the Atlantic Ocean. The constant skirmishes between these two powers developed into the Battle of the Atlantic, as both sides looked to gain supremacy. The Atlantic Ocean represented an important stepping-stone for the Allies to end the war. The Allies needed full control of the Atlantic to organize the invasion of Europe, while the Germans saw the Atlantic as a barrier protecting Germany’s Western flank. The need for both the Allies and Axis powers to control the Atlantic caused the conflict to rage from the beginning of World War II in 1939 until the German surrender in 1945.

The complexities of the Battle of the Atlantic forced the Allies to improve the tactics, technologies and training of their forces. The Battle of the Atlantic consisted of the truly devastating German submarines, known as U-Boats, and a rapidly improving Allied air force. Both these units discovered new methods of fighting and implemented more advanced technology to give them an edge in the Atlantic. Both the Axis and Allies developed more convoluted and intricate equipment. As a result, the operators needed more education to properly use them. Thus, a lack of trained personnel at times rendered
technological advances useless. Mastering the technologies and tactics of Atlantic patrols allowed for American pilots to help the Allies win the Battle of the Atlantic.

In this Independent Study, I focus on the training of aircrews as the reason why the Allies ultimately won the Battle of the Atlantic. Most authors who write about the Battle of the Atlantic attribute victory to multiple factors, including training. However, these historians only give the reader a glimpse of the complicated training situation. This thesis examines the different phases of training in regards to anti-submarine warfare, thus giving the reader a comprehensive look at another factor in the Allied conquest.

As I previously stated, none of the prominent historians writing on the Battle of the Atlantic detailed the changes of training for anti-submarine aircrews. These different books discuss multiple topics, and therefore aspects like training lack the necessary explanation that would allow for a comprehensive understanding into the importance of the human element. My Independent Study reinforces the current belief that training helped win the Battle of the Atlantic, but I have also gone further to explain why and how. I describe specific curriculums and how the level of training coincided with different stages of the Battle of the Atlantic. The Battle of the Atlantic held a key part of the Second World War where both sides worked to control the ocean. Therefore, improving the Allied aircrews held a key component in winning the Battle of the Atlantic.

The historians who write about the Battle of the Atlantic only award partial credit to Allied training for the Allied victory in the Atlantic. These authors explain the importance of the men involved in the conflict as a reason for the Allies’ victory in the Battle of the Atlantic. For example, S.W. Roskill, the author of the multi-volume *War at*
Sea, explains how endurance, skill and moral purpose of the men became pivotal in the outcome of the battle. He stated that since the Battle of the Atlantic contained “no limits in time or space,” and the battlefield had no specific boundaries, the drive of the men won the battle. Thus, Roskill touches on the importance of training in the final victory. He states how technology simply aided the men as they fought the U-Boats.¹

Another author, David Syrett, strongly attributes German failures in explaining the Allied superiority in the Atlantic. He first states that the German high command never discovered an effective way in countering the Allied convoy system. The inability for German U-Boats to make a successful attack on a convoy prevented the U-Boats from achieving their number one objective, to cripple the Allied economies. Syrett explains that in both World War I and II the Germans needed to develop a better strategy for sinking the Allied merchant vessels due to the effectiveness of the Allied convoy system.²

Secondly, Syrett explains that the Germans inadequacies in intelligence work hurt their chances of success. The U-Boats had incomplete knowledge of convoy routes in the Atlantic because most commanders only had information from deciphered radio messages from the Allies. Once the Allies changed their code, the Germans had to rely on their air command, the Luftwaffe, for sea locations. Unfortunately for the Germans, the coordination between the air and land branches lacked any cooperation.

David Syrett goes on to describe technological faults for the German defeat. The U-Boat, although improved from the model in the First World War, still contained obvious flaws. The Germans never fixed the problem of making their submersibles more

¹ S.W. Roskill, The War at Sea: II, 355.
² David Syrett, The Defeat of the German U-Boat: The Battle of the Atlantic, 259.
submarine like. A submersible, like a submarine, has the ability to submerge itself beneath the water. However, a submarine, in contrast to a submersible, can operate effectively underwater. Once a U-Boat sunk below the water, many of their abilities became inefficient. For example, the speed of a U-Boat underwater decreased to such a level that even the slowest merchant ship outran it.

Syrett finally explains that the German military never took advantage of scientific researchers to improve their forces. This made ASWORG, an American organization devoted to scientific analysis to improve weapons and strategies, that much more important since Germany failed to implement a similar force. Syrett touched on the importance of improvement through scientific thought. The Germans lacked essential advice on how to fix current techniques or tactics. Without an organized group devoted to researching and analyzing U-Boat strategies, the Germans had no chance to use their machines to its full potential.

The last prominent author on the Battle of the Atlantic, Samuel Morison in his book, *The Battle of the Atlantic*, weighed in on how the Allies achieved victory in the Battle of the Atlantic. He explained that no ‘one’ answer could describe how the Allies won. Instead, he writes that we must look to several different reasons that together, pushed the German U-Boats back. These reasons included better technology, tactics, resources and training. He then builds a connection between all of the aspects above, explaining, “Coastal convoys were impossible without more escorts and patrol planes; ships were ineffective without proper detection devices and offensive weapons; these in

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3 Syrett, 259-264.
turn needed operators trained in special schools… This explanation shows a certain correlation between training and other factors as a reason why the Allies won the Battle of the Atlantic. Therefore the Allies’ focus on training helped them not only control the Atlantic Ocean, but also attain total victory in World War II.

Both the Axis and Allies focused on the Atlantic Ocean because the Battle of the Atlantic influenced future operations in the Second World War. For the Allies, safety in the Atlantic permitted European operations. The Allies needed to transport equipment and soldiers to open a new front in Europe.\(^4\) The Axis powers saw the Atlantic as a way to tie down Allied resources and to prevent a European invasion.\(^5\) The Battle of the Atlantic represented a first line of defense in the war. Whoever controlled the Atlantic had the ability to coordinate more devastating attacks on the other. Thus, the victor in World War II needed to win the Battle of the Atlantic. To do this, every country worked to advance their armed forces. Besides improvements in personnel, technology helped to give the Allies an advantage in the Battle of the Atlantic.

In the Great War, from 1914 until 1919, technology entered a new domain; its successes motivated every military force to further develop its weapons. In World War II, the experimental technologies of the early 20\(^{th}\) century took incredible leaps forward. Technology in the field of battle caused a drastic change in strategy. Weapons like the tank, airplane and submarine entered World War I as an improved way to achieve victory. The first tank, known as a “land ship” first fought in the Battle of Flers-Courcelette in 1916, as a way to cross enemy trenches. Although the tank struggled to


\(^5\) Richard Hough, 306.

operate effectively, they overpowered German defenses. Airplanes held observational and attacking roles in the First World War. Each country created its own air unit years before 1914 and as a result their uses aided each side during the entirety of the war. The U-Boat, like airplanes, existed years before the First World War and similar to the tank, needed further development to operate at a level of superiority. All three of these weapons changed the doctrines of battle and military strategies. A new form of warfare emerged and like the technology, the crews of each weapon needed to master the instruments to fight at an optimum level. In a sphere where machinery expected to enter with the certainty of ascendancy, the military needed their personnel to improve too. This meant that those operating advanced equipment had to learn their respective machines. In the Battle of the Atlantic, pilots proceeded to master their airplanes and the technology inside. Only when man and machine both worked harmoniously, did they evolve into an effective entity.

After the Japanese attack on Pearl Harbor, America entered a war unprepared to defend its shores. America did not have enough pilots to effectively patrol their Eastern coastline. The trained aircrews in both the Navy and Army Air Force operated in the Pacific theater due to the immediate problems from the Japanese. The crews that patrolled the Atlantic Ocean had little training, if any, in anti-submarine operations. These men made many mistakes that cost the Allies tons of supplies needed in the war effort.

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8 Lee Kennett, *The First Air War 1914-1918* 218-221.
American pilots made numerous mistakes in the first few months of the war. Pilots sent to protect the coast conducted missions in a completely unfamiliar setting from where they trained. Army Air Force pilots, untrained in anti-submarine patrols, picked up the slack for the Navy in anti-submarine operations.\(^\text{11}\) It took time for Army Air Force pilots to learn how to conduct searches and attacks on this new enemy from scratch.

Non-military personnel also joined the U-Boat war. The Civil Air Patrol (CAP) consisted mostly of men unfit for service, since most able-bodied men joined the military. This included those above and below the age limit, and those with a physical ailment that prohibited them from joining the military.\(^\text{12}\) With the equipment the Civil Air Patrol had, they helped the war effort tremendously. However, when it came to attacking U-Boats, CAP pilots did not have the needed training to understand how to improve on their abilities.

The training programs in the military also failed in preparing incoming pilots for the complexities of anti-submarine operations. Early American training facilities, during World War II, had not prepared for the immense increase in students and therefore they lacked the resources to train.\(^\text{13}\) These programs worked to reorganize themselves in order to create a clear and concise path for their pilots in training to follow.

After months of overall failures in anti-submarine warfare, the Army and Navy called on the brilliant and relatively untapped minds of American scientists. The military

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hired civilian scientists to analyze the shameful situation in the Atlantic and to give the military advice.\(^\text{14}\) Researchers concluded that Allied pilots did not properly use the technologies, techniques and tactics essential for protecting Allied cargo ships. Only after operations researchers studied the low amounts of U-Boats sunk did the American military realize what to teach all of their pilots.

When it came to technology, aircrews did not use their depth charges effectively until the analysts made recommendations. A weapon first created for use on ships, the depth charge had a deeper detonation setting. On a ship, this later setting allowed for the Allied vessel to travel out of range before the charge exploded. When the depth charges moved to airplanes, this previous setting failed to damage a majority of their targets because aircrews dropped their charges on top of a patrolling U-Boat. The deeper setting that the Allies used for protecting their ships, instead allowed for the U-Boat to escape from harm.\(^\text{15}\) Operations researchers discovered that a shallow charge exploded at a lethal distance more often.

The Army and Naval air forces, like anti-submarine technologies, also neglected proper technique in the first few months of 1942. The ways in which an airplane flew and attacked a U-Boat, allowed for their target to get away. Too often Allied aircrews initiated their attack run when they realized that the U-Boat had already started to safely submerge making it unlikely for these aircrews to make an effective strike.\(^\text{16}\) The next


aspect of the Battle of the Atlantic that scientists studied enabled pilots to make a surprise 
attack on a German submarine. This included camouflage and baiting techniques. 

The method of searching for a U-Boat also joined with technologies and 
techniques as an aspect of anti-submarine warfare in need of improvement. What use 
would an effective attack run and proper weapons settings have if aircrews could not 
locate the U-Boats on route to the American coastline? Operations researchers analyzed 
the best pattern to search for U-Boats and the length of each mission. Specifically, these 
scientists found out the impact that altitude had on spotting an enemy submarine.17 

In the end, operations researchers transformed anti-submarine warfare during 
World War II and they also demonstrated how training positively influenced Allied 
effectiveness in the Battle of the Atlantic. The discoveries made by civilian analysts not 
only modified what training programs taught, but they also introduced new material for 
these facilities. Anti-submarine warfare was a relatively new concept for America, 
especially on the scale at which they had to fight. Operations analysts studied an 
unfamiliar battle and their discoveries added much needed information for every Allied 
pilot, both in training and in the field.18 

The analysis made by civilian scientists combined with the improvements of 
training commands developed an air arm ready for anti-submarine operations. Aircrews, 
with improved training, attacked more U-Boats, sank more U-Boats and the lethal 

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17 Professor C.H. Waddington, 162. 
18 The Army Air Force Antisubmarine Command published a monthly summary report on anti-submarine 
operations. Some of the chapters detailed the problems with aircrew attacks or new techniques to try. I 
placed a more descriptive synopsis of these reports in the annotated bibliography.
percentage of each attack increased greatly. After August 1943, Allied forces controlled the Atlantic Ocean and merchant vessels traveled to their destinations safely.

For the United States, once the Battle of the Atlantic began, they struggled to defend their territory. A lack of training contributed to the inadequate protection made by American pilots. Aircrews had little knowledge in anti-submarine operations or how to use the technologies onboard. Only after the United States focused on building up anti-submarine personnel, did they subdue the German U-Boats.

In an ever-evolving battle that cost the Allies millions of dollars, the Battle of the Atlantic showed its relevance in winning the Second World War. After the Allied victory against the U-Boat, the United States targeted the European mainland. Although advances in technology and proper implementation of airplanes helped to defeat the German submarines, without trained aircrews patrolling the Atlantic the Battle would have raged on for much longer. The Allies needed to learn how to use the technology available in order to increase the strength of the American defenses.

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CHAPTER ONE

THE BATTLE OF THE ATLANTIC:

A LOOK AT THE CONFLICT¹

Both the Axis and Allied powers saw the significance in controlling the seas, and more specifically, the Atlantic Ocean. Since the Atlantic separated the United States and Great Britain, the ability to trade effectively depended on who dominated the waters. Also, considering the fact that the English Channel divided Great Britain and Nazi occupied France, naval dominance affected the competence of an invading force. The importance of the Atlantic compelled both countries to send their forces in an attempt to gain full control. The subsequent conflict evolved into the Battle of the Atlantic.

The Battle of the Atlantic matched the newly reinforced Allies against a uniquely altered German Navy. Germany, a landlocked country had little hope in building a surface Navy powerful enough to fight Great Britain. In response to this weakness, they capitalized on their experimental use in submarines from World War I. Germany commissioned hundreds of these U-Boats to take part in patrolling the Atlantic for Allied ships, later named the Battle of the Atlantic. Germany improved on the technologies and strategies of the German submarines implemented during the Great War, thus making them a lethal force.

The German U-Boats served as Nazi Germany’s best weapon in the Atlantic, despite their difference with traditional surface vessels. The damage a U-Boat dealt came

¹ For this chapter I used mainly secondary sources to provide information into who, what, where, when, why and how of the Battle of the Atlantic. This chapter provides essential background information in the battle, thus allowing me to argue my point effectively. One primary source that I utilized in this chapter was Samuel Morison’s *Battle of the Atlantic*. He saw the immense effort involved in the Battle of the Atlantic and wrote about the Battle’s complexities.
from their torpedoes. This self-guided weapon moved towards other objects and exploded on contact. Early in the war, compressed air propelled the torpedoes. This method created a trail behind the torpedo that allowed for the evasive maneuvers of Allied ships.\(^2\) Since Germany improved their escaping and attacking capabilities in the first months of the war, the U-Boats harassed and sank hundreds of Allied ships. Also, because U-Boats took the initiative in Atlantic operations in 1940 and later in 1942, the field of battle changed in favor of the German submarines. The change in scenery and tactics bought the Germans more time as a superior force in the Atlantic. But, in time, the German U-Boats suffered from technological stagnation. Admiral Doenitz, the German commander of the U-Boat arm, categorized the German U-Boat as a diving vessel instead of the popular impression that this ship functioned forcefully under water.\(^3\)

German U-Boats acted less like submarines and more like submersibles, making them a useless weapon underwater. A submarine describes a ship that can navigate underwater, while a submersible only has the ability to submerge itself. Although a U-Boat can in fact navigate underwater, its incapability to maneuver and its lack of speed most likely explained the Admiral Doenitz’s characterization.\(^4\) Once a U-Boat operated below the surface, their effectiveness decreased dramatically. Specifically their movement and attacking capabilities worsened. Underneath the surface a U-Boat moved slower than even the slowest merchant vessel. More often then not, a patrolling aircraft protected countless cargo ships, simply because they flew over a U-Boat as it tried to get close to a convoy. Due to the poor capabilities of a U-Boat underwater, commanders needed to operate on the surface in many cases. This created a favorable opportunity for

\(^3\) Mason, 14.
\(^4\) Henceforth I will refer to the submarines as submersibles.
Allied aircrews since they could only find and attack a U-Boat on the surface of the water. Above the water, U-Boats could manage to sail at a brisk seventeen knots, faster than an Allied cargo ship. On the other hand, once the U-Boat submerged its speed slowed to three knots. This rendered them incapable of catching even the slowest Allied ship.\(^5\) The inadequacy of the U-Boat to operate effectively beneath the surface gave the Allies a key advantage in the Battle of the Atlantic. The Allies first needed to counter the German U-Boat tactics.

Before America entered the Second World War, German submersibles attacked lone merchant vessels independently. This battle doctrine gave the Germans early successes in the war. The Germans enjoyed early victories with this strategy due to the carelessness of the Allied navies to develop new technology and tactics in the thirty years between World Wars.\(^6\) With little or no protection from other vessels, German submersibles sank countless merchant ships. U-Boats preyed on merchant vessels that operated without protective support because merchant ships lacked defensive technologies, making battles with U-Boats one sided. Only when the Allies implemented effective countermeasures did the German Navy change their strategy.

The Allies chose to implement escort vessels, which had the capability of sinking a U-Boat, as a key countermeasure to protect a merchant ship. Unfortunately, this tactic took time to organize because of the scarce number of resources available for protective missions. America, like Great Britain, clung to a traditionalist idea pertaining to the future of their respective navies. The United States’ built their naval forces under the


direction of a “big gun in a big ship.” As a result, the American Navy had scarce amounts of escort and smaller vessels needed in anti-submarine operations.7

It took some time before Great Britain realized the best strategy against the German submersibles. Early in the war the British military ordered their Navy to go on the offensive and to search for any U-Boat across the Atlantic. This meant that less resources and ships were available to protect the merchant vessels.8 Great Britain needed to find the best way to stop Germany’s success against their merchant ships.

To prevent the U-Boat from sinking any more merchant vessels, British commanders implemented a convoy system to protect cargo ships. Convoys existed long before the Second World War, and the Allies used this tactic quite often during the First World War to combat the U-Boats.9 A convoy joined several different cargo ships going to the same destination with escort ships. These escorts surrounded the merchant vessels and deterred any U-Boat from attacking them. In response, the Germans began to attack convoys with several U-Boats simultaneously.

These groups of U-Boats, known as “Wolf Packs,” spread out and fired at convoys making their protection techniques ineffective. In these “Wolf Packs” one single U-Boat spotted a convoy and would alert all nearby submersibles to converge at their position. The Allies needed to either track U-Boats before they got in lethal range or have one of the ships in the convoy keep the submersibles occupied by patrolling the waters where they spotted a U-Boat. The improvement of radar and other detection technologies served to help any ship avoid a U-Boat. Airplanes helped the Allied convoys by keeping the submersibles busy before they reached their destination.

8 Roberts, 356.
Aircraft helped patrol the Atlantic Ocean to aid in a battle whose frontlines extended for thousands of miles. Since the submersible could hide below the surface, it turned into a hard target to find, let alone sink even for convoys. Aircraft solved the problems of having to search for a patrolling U-Boat. Airplanes achieved a greater distance and speed than surface vessels. Once an airplane caught a U-Boat they could call for ships and even other airplanes to join in the fight. Both sides understood the importance of air power and used planes for reconnaissance and for attacking. This made the Battle of the Atlantic more than just a naval engagement.

The break away from the cliché naval battles, where battleships fought at close range as seen a century before, forced the Allies to change from their traditional strategies to more contemporary ones, which involved the implementation of aircraft as a crucial actor in the battle. These new methods of naval engagements pushed the Allies to both improve on existing weapons and to develop new ways to fight an elusive enemy. In response, Germany expanded and strengthened their U-Boats to counter new Allied advancements. The constant evolution of new technologies and policies by both sides created a seesaw of advancement that forced both the Allied and Axis powers to plot their next tactical move.

Merchant shipping emerged as the focus of this battle, and therefore the reason why both sides searched for any advantage. The Allies attempted to protect their cargo ships in order to continue the war effort. The Germans used their resources to sink the cargo ships in a struggle to starve the Allies. As their objective, Germany attacked merchant vessels moving toward England, in an attempt to destroy Allied trade routes. In the first few years of the war, Germany succeeded in their goal of strangling Great Britain
economically. Without a secure ocean, the American and British forces could not hope to deal a decisive blow against Nazi Germany. For the Germans, this battle protected their acquired lands in Western Europe. The Allies would not dare to invade Nazi occupied Europe when submersibles still patrolled the Atlantic Ocean effectively. In the first few years of World War II, Great Britain worried about her future.

Less than a year after the Second World War began, the Allies performed at a disadvantage. With Germany’s conquest of France and the Low Countries in 1940, the German Navy had three thousand miles of coastline to operate in, instead of the three hundred miles restricted to Germany before the war began. Thus, German forces evaded the English Channel. The channel became an effective bottleneck against the U-Boat because the British ships could better find and attack the U-Boats in the concentrated waters that separated Germany and the Atlantic Ocean. These submersibles functioned effectively in the Atlantic Ocean against the British military and economy because they operated throughout the Atlantic. Conducting naval operations against this new kind of weapon did not overly concern British commanders and therefore the amount of change necessary did not occur.

With this disability of fighting the Germans across thousands of miles, Great Britain relied on her ally across the Atlantic. The United States Government agreed to help the British Empire against the Axis powers while still staying neutral. Prime Minister Winston Churchill appealed to the Americans for support, explaining how the German U-Boats have strangled Great Britain’s economy. The United States helped

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11 Hough, 12.
12 Hough, 43.
their ally by trading fifty old destroyers for British bases overseas.¹³ These ships helped the British forces in their convoy formations that protected their merchant ships. The United States benefitted from this trade since the destroyers exchanged had little use for America. The United States, at the time, had not declared war on the Axis powers. Their resources had not been stretched like it’s soon to be ally, Great Britain.

The Battle of the Atlantic took both the Allies and Axis powers to places far from their bases. The German U-Boats operated off the coasts of England, France, United States, Caribbean, Newfoundland and Western Africa. At the beginning of the war, the German submersibles took advantage of the unprepared Allies, stretching their resources. Their U-Boats sailed from one coast to another with little worry of being sunk. Once Allied forces realized the potential of aircraft along with its sharpened abilities, U-Boats had to patrol waters unavailable to aircrews. Finding a gap that prevented Allied forces from unleashing their airplanes allowed the U-Boats to remain effective even though the Allies surpassed their elusive tactics. The Mid-Atlantic gap, an area in the Northern Atlantic out of range of Allied airplanes, became the final sphere of this extensive battle. It took the Allies roughly six months to close this pocket, ending a conflict that lasted almost as long as the war itself.

Airplanes enabled the Allies to add different and more effective weaponry to the battle. Unlike battleships, airplanes could search further distances and safely operate above the water. Even if an airplane failed to sink a submersible, their presence scared the U-Boat enough that it submerged. The advantages of aircraft included their ability to search, find, and attack any ship on the surface of the water. Once a submersible sank below the water, aircrews had little power to damage them. Also important, the U-Boat

¹³ Cant, 33-34.
had little power against the Allies when they operated underwater. The inabilities of the German submersibles to operate productively beneath the surface allowed for more effective Allied countermeasures.

America spent a large amount of time and money to fight and eventually win the Battle of the Atlantic. Lieutenant Commander Samuel Morison, a naval historian who served during World War II, commented that, “The amount of study, energy and expense necessary to combat a few hundred enemy submersibles is appalling.”\textsuperscript{14} Fiscally, he states that in counting the ships and time lost in the Battle of the Atlantic the Allies spent, “…some hundreds of billions of dollars…”\textsuperscript{15}

In a battle that took many years and that occurred all over the Atlantic, each side incorporated different resources in an attempt to gain an upper hand. Technological advances, intelligence information and even the proper application of aircraft drastically helped both sides in the battle. A less publicized aspect that bolstered the Allied Atlantic force was aircrew training. What use did technology have if the men operating them could not use them effectively? Only when aircrews and airplanes operated harmoniously did they destroy the U-Boat menace. In England, Winston Churchill described Great Britain’s conflict with the German U-Boat, “Such is the U-Boat war – hard, widespread and bitter, a war of groping and drowning, a war of ambuscade and stratagem, a war of science and seamanship.”\textsuperscript{16} In a campaign that took place on a battlefield the size of the Atlantic Ocean, the ideas of a simple battle were thrown out.

\textsuperscript{15} Morison, 204.
\textsuperscript{16} Roberts, 346.
"After years of blackout conditions in Europe the [American] shoreline looked like a carnival." Marc Milner, a historian on the Battle of the Atlantic, made this comment to describe the reaction of the first U-Boat commanders operating in American waters. The stunning realization, that America lacked the preparation for anti-submarine warfare, made by the U-Boat commanders represented America’s failure to anticipate the German onslaught. The inability to fully develop anti-submarine defenses afflicted America’s shipping once the first U-Boats attacked. The United States soon recognized that their current strategies were ineffective against the submersible menace. The amount of cargo sunk in the first couple months of the war and the gross failure of attacks on U-Boats compelled the German forces to call this offensive the “second happy time.” The first, being off the English coast in 1940 when the U-Boats decimated English shipping.

The German submersible force under Admiral Karl Doenitz enjoyed relative ease in slaughtering Allied merchant vessels because the aircrews protecting these merchant ships lacked proper training. The Allies needed to improve aircraft technologies, and increase the amount resources for anti-submarine warfare, but they also needed to train their pilots in newer techniques that readied them for anti-submarine operations. Many of

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1 For this chapter I used a variety of sources both primary and secondary to detail the training that aircrews patrolling received. In one specific case I found a memoir of a pilot in World War II who recorded his training as a cadet. I use his memoir in order to explain the training of Naval aviators during the Second World War. I also use newspaper articles to demonstrate how the American citizenry saw the U-Boat invasion and the failures of American pilots. Finally I utilized intelligence reports from 1943 in order to explain certain problems that pilots experienced when patrolling the Atlantic.

2 Marc Milner, Battle of the Atlantic (Ontario: Vanwell Publishing Limited, 2003), 83.
the aviators assigned to patrol the Atlantic Ocean for U-Boats never practiced in the techniques of anti-submarine warfare. Also, most of the tactics of anti-submarine operations had yet to be discovered. After actual patrols, the United States military noticed the failures of aircrews. These inadequacies allowed for the German submersibles to stalk and sink Allied merchant vessels.

Since the German submersibles surprised the American defensive forces, U-Boats sank a massive amount of merchant cargo. From January until April 1942, America’s Eastern Coast, known as the Eastern Sea Frontier, took the most damage. Between these months, the Allies lost an average of over 20 ships and over 120,000 gross tons of cargo.\(^3\) After April 1942, the Germans began to move towards America’s Southern Coast. In this area the Germans sunk an average of twenty-six ships a month and over 125,000 gross tons of cargo.\(^4\) A failure of training the pilots in effective anti-submarine tactics led to the large loss of cargo and, more importantly, the survival of the German submersible force.

When examining the failures of aircrews, I focus on the attacks made on the U-Boats and the amount of German submersibles sunk. German U-Boats, for the most part, submerged at the first sight of an airplane. This prevented aircrews from sinking the submersible. While underwater, a U-Boat moved at such a sluggish speed that merchant vessels got away safely.\(^5\) When the aircrews missed their target, the submersibles simply reemerged and stalked the next vessel. Under these circumstances, it did not matter how much training the pilots received. This game of cat and mouse could have gone on for years because of the insignificant damage dealt to the U-Boats or the Allied airplanes.

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Only after the aircrews started to attack these German forces effectively, did U-Boat commanders weigh their options on retreating. Regrettably, months passed before competent attacks pushed the German forces away from the Western Atlantic.

In the first half of 1942, American aviators, ordered to protect the United States’ shoreline, failed to do their duty because they lacked adequate training in anti-submarine operations. Anti-submarine warfare evolved throughout the Battle of the Atlantic; thus every pilot needed updates on how to conduct these operations. Specifically in anti-submarine operations, search and attack methods changed constantly. The United States had to improve their current technologies in order to get an edge in the Battle of the Atlantic. The complexities of anti-submarine warfare also caused the Allies to discover new tactics and techniques useful in destroying U-Boats. The progress of anti-submarine methods that were developed and enhanced, forced every pilot to continuously train in new approaches to combat. Even trained Naval aviators before Pearl Harbor needed experience in anti-submarine operations to improve their abilities. At the beginning of the war, American pilots had little knowledge in the proper ways of patrolling the Atlantic. Only after both pilots and scientists could observe the battle more closely, did pilots learn how to effectively attack and sink the Axis submersibles. Even though the current strategies needed improvement, the Navy had the best training for this kind of warfare.

At first, Navy did its best to protect the coast. Unfortunately the Navy lacked the proper organization of their training commands, which hindering communication between divisions and the establishment of a single lesson plan. Besides this problem, the Navy withdrew from the Atlantic because of Japan’s successes in the Pacific. This left other pilots, untrained in Naval engagements, as defenders against a well-prepared U-
Boat force. The first of these pilots were from the Army Air Corps later renamed the Army Air Force.

The Army Air Force only had jurisdiction in land-based operations, making Atlantic patrols an unknown area of operations. Also the Army Air Corps needed to reform its organization to better prepare the cadets. Pilots rushed through training to increase the number of aircrews available. This drastic move for growth of the Army Air Corps confused Allied commanders in charge of training. Besides these faults, all Army Air Force pilots went through preflight and flight training, which taught the pilots how to effectively fly their airplanes, unlike the Civil Air Patrol.

The Civil Air Patrol, an air unit comprised of American civilians, joined the Army Air Force as a unit devoted to anti-submarine patrols but these civilian pilots never had training in anti-submarine operations. The Civil Air Patrol worked to take the pressures off the military pilots ordered to search the coastline. Although this group greatly boosted the security off the American coast, the members of the Civil Air Patrol lacked eligibility for military duty. The United States, in the first few months of 1942, expected these pilots to only search for U-Boats and communicate with the military so that the Army and Navy Air Forces could attack them. Over time, the Civil Air Patrol pilots began carrying bombs and depth charges to engage the German submersibles. Due to the lack of training in anti-submarine warfare, these civilian pilots had little success in destroying the German U-Boats. A successful unit needed to master the tactics and technologies of anti-submarine warfare.

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For every pilot, the advancement of anti-submarine technologies hurt their ability to patrol the Atlantic because of the slow speed it took to implement new technologies in American airplanes. The United States barely started to improve the detection and attacking technologies on their airplanes, making a majority of pilots rely on their untested abilities in the Atlantic. Also, once the military added new technologies to the airplane, pilots still needed to learn the ins and outs of these machines. In some cases the pilots failed to apply these technologies correctly.

All of these reasons mentioned above interfered with America’s attempts to thwart the German submersibles. These examples share a common theme: that the United States did not have much knowledge in modern anti-submarine operations when they joined their British Allies in the Second World War. Due to that fact, the Allies lost a significant amount of merchant vessels and cargo.

From the beginning of World War II, the United States fought an up-hill battle to secure the Atlantic Ocean. After the unexpected attack on Pearl Harbor, the United States entered into a war that it was not entirely prepared to wage. Japan invaded the Philippines after the surprise attack on Pearl Harbor, forcing America to deploy its forces to the Pacific. The American citizenry later realized that not just Japan, but also Germany advanced into U.S. territory. In the hopes of disrupting the United States’ trade routes and decreasing the amount of resources sent to Great Britain, the German Navy ordered their experienced and menacing U-Boats to attack merchant vessels on America’s Eastern coast. The German attack, known as Operation Drumbeat, sent several U-Boats to prey on the defenseless Allied vessels in the Atlantic.\(^7\) Pilots resisted the incursion and ordered

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patrols to search for any German vessel. The Navy operated with a diminutive air force of trained personnel, but not even proper schooling qualified them for the task at hand.

Experienced pilots still required more guidance to accurately attack German U-Boats. Throughout the Battle of the Atlantic, pilots worked with newer technologies and tested different tactics. Even though having an experienced aircrew strengthened American defenses, much more than the cadets just out of flying school, they still had much to learn. Anti-submarine warfare calls for special skills of the pilots in order for them to have a significant impact.

Air forces that conducted anti-submarine operations had different equipment and tactics than aviators trained in dog fighting, where two planes fought to destroy each other, or area bombing, where a plane dropped several bombs on a ground target. Samuel Morison, a prominent World War II Naval historian writes, “Both Navies recognized early in the war that normal naval training was not enough to qualify sailors to hunt and kill submarines; special training was required not only in tactics, but in radar, sonar, depth-charging, air-bombing, and the use of a variety of weapons.”8 When the United States entered World War II, American aviators could not conduct anti-submarine operations at a maximum level. They did not have the specific training, a general doctrine, or experience to properly teach students the efficient techniques to sink a U-Boat.

Proper schooling helped pilots in their mission, but experience further improved these same pilots. Experience gave pilots key information that they did not previously realize. The more missions a pilot went on allowed the military to accurately see what

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attack methods worked, and how the U-Boat responded to these strikes. In early campaigns, like the German thrust against the American coast, aviators did not have any familiarity with this relatively new kind of warfare. The most efficient procedures, “had to be learned through actual experience, and, owing to the urgent need for Antisubmarine patrols, the air units were forced to accomplish their training in the course of operational missions.”\(^9\) Since pilots in their first few missions never practiced in the kind of warfare expected from them, they made many mistakes. Despite a lack of experience, trained Naval aircrews had a major advantage over the other pilots because the Navy provided classes that prepared their cadets for patrol bombing missions.

Naval aviation training prepared cadets for a variety of water-based operations, including anti-submarine operations known as patrol bombing. Before entering combat, all naval cadets went through an extensive curriculum that included pre-flight training, primary training, intermediate training, and operational training.\(^10\) All of these divisions came together and produced pilots with the best skill-set to fight the U-Boats in 1942.

After pre-flight training, where the pilots readied themselves for the physical demands of the United States Navy, the pilots moved on to Primary Flight Training.\(^11\) During this two-month event, the cadets learned how to operate an airplane.\(^12\) In Intermediate Flight Training, the pilots requested in which type of duty they wanted to specialize, although in some cases the Navy did not listen to the pilots’ request.\(^13\) In the

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first step in this training, the pilots reviewed what they learned in Primary Flight Training but with a heavier aircraft. The heavier aircraft more closely resembled the plane the cadet would fly in combat. The pilots then mastered in-plane instruments and subsequent navigation. Later, these pilots separated to study the specifics of their individual duties. This part of the training program taught pilots the intricacies of patrol bombing, which the Army Air Force and the Civil Air Patrol did not address.

The Naval cadets whom the Navy designated as patrol bombers (VPB) trained for ninety hours in six stages: familiarization, instruments, navigation, formation, bombing, machine gunnery, and night familiarization.\(^\text{14}\) After the cadets completed intermediate training they received their wings, making them Naval Aviators. These Naval Aviators soon moved on to operational training.\(^\text{15}\) During operational training, the pilots learned more extensive information pertaining to their chosen field. The VPB pilots assigned to anti-submarine missions, learned particular bombing techniques. Also at this stage, the rest of the crew needed to operate with the pilot, such as the navigator, joined with their pilot to work as a unit.\(^\text{16}\) Although the curriculum for pilots gave the cadet necessary information and practice, the organization of the divisions needed better communication between the commands.

Indirect communication between the Navy department and the individual air stations, where the training and operations occurred, hurt the Navy’s ability to correspond with each other. In Pensacola, Florida, the commandant of the Naval district acted as a field representative between the Navy department and the Naval Air Stations. This kind of communication became, “merely a routine, time-consuming operation, for the

\(^{14}\) U.S. Bureau of Aeronautics, 29-30.  
\(^{15}\) U.S. Bureau of Aeronautics, 31.  
\(^{16}\) U.S. Bureau of Aeronautics, 31.
commandant rarely had on his staff any officer who was familiar with naval aviation.”

Thus, correspondence between the Navy Department and each station went through personnel with little knowledge in Naval aviation, before the message reached its destination. Another demonstration of the Navy’s ineffectiveness occurred in December 1940. A subcommittee of the committee on Naval Affairs in the House of Representatives visited Naval Aviation training activities and concluded that in its current state, training facilities functioned in an unsatisfactory condition. The Naval bases operated in thirteen different districts and a man with no experience in Naval aviation first interpreted general policies.

The Navy trained intensively in patrolling waters in the years before Pearl Harbor. Besides the fact that anti-submarine operations entered as a new form of battle for the United States Navy, the training, which naval aircrews received in early 1942, occurred years before Pearl Harbor. Although these aircrews did not practice attacking U-Boats, they became experts at using their equipment and patrolling for large amounts of time, needed for anti-submarine operations. Sadly, with the dire situation in the Pacific, the amount of naval aviators in the Atlantic coast decreased substantially.

The United States Navy had the overwhelming responsibility of protecting both the Atlantic and Pacific Oceans. The Navy later stationed most of their forces in the Pacific at the beginning of the war. With most of the American citizenry and military focused on the Pacific theater, Germany’s submersibles enjoyed the relative ease in

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18 Lt. (jg) George M. Fennemore, 6-7.
sinking cargo ships. The United States Navy did have some squadrons in the Atlantic but they did not have adequate resources for the immense task in front of them.

In January 1942 the Naval air force had four squadrons of Catalina flying boats, one squadron of Mariners and one of Hudsons. The Navy divided some of these squadrons to cover large amounts of water.²⁰ Since the Navy had a lot of experience in above water missions, these pilots had an effective presence on the American coast. Compared to the other American Air Forces in anti-submarine operations, the Navy, when effective, excelled at destroying submersibles; however, in the overall scheme of U-Boat attacks, Navy pilots’ skills remained rudimentary for the first few months of the war. The Navy credited their aviators with the first two submersible kills of the war and the only air power credited with a kill in the first six months of 1942. Specifically, Navy was credited with five U-Boat kills in the first six months of 1942. This six-month stretch had the least amount of kills in the entire war.²¹

Since the Navy needed help in patrolling the Atlantic, two other protagonists, the Army Air Force and the Civil Air Patrol joined the battle. Focusing on the failures of all of these forces adequately explains the effect training had in Atlantic operations. The Army Air Force had trained pilots operating before the attack on Pearl Harbor as well. These men knew how to properly navigate and use their equipment essential in submersible warfare. Like their naval counterparts, the United States sent these trained aviators to Pacific bases to protect American interests.²²

Due to the unexpected service of AAF in anti-submarine operations, the AAF rushed to create a training curriculum. The United States did not establish the Army Air Force until 20 June 1941. With Hitler’s military conquests in Europe, the United States began to prepare for war. The United States Army Air Corps, later renamed the Army Air Force, trained their pilots for war. The United States’ Government needed qualified pilots incase the war in Europe or Asia spilled over to the Americas. The rush to produce aircrews caused the training system to develop while pilots attended training school. “Facilities were secured, teachers were hired, and textbooks were written while the first classes were being held.” This disorganization demonstrates the chaotic situation that the Army Air Force dealt with as they attempted to prepare their forces for combat.

The large increase in aviators did not help strengthen the Air Corps, because the training facilities needed more time to prepare for more pilots. The training facilities struggled to properly train their aviators by the program’s earlier deadline. The Army Air Corps had to choose whether they wanted more pilots training with them, or fewer and more prepared graduates. The written work, “Combat Crew and Unit Training in the AAF” responds to this difficult decision: “Time is pressing and it is not available for turning out individuals who meet the standards of perfection which have been set up in the past under a peacetime program.” Aircrews rushed through their training in order to increase the strength of the Army Air Force. This urgency to commission more and more pilots caused the skill of these aviators to worsen, compared to aviators in service years

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before Pearl Harbor. The United States focused too much on increasing their numbers
than developing their pilots’ readiness.

The organization of training in the Army Air Corps also suffered in the years
leading up to Pearl Harbor, because the command structures separated prior to 1942. The
Army Air Corps made a few improvements, prior to Pearl Harbor but the organization
slowly decentralized.27 This division of power further complicated the preparation of
these pilots. This decentralization of training facilities caused overlap between the
different groups. In the summer of 1941, the Chief of the Training and Operations
Division complained to the Chief of the Air Corps that some training actions occurred
without his knowledge.28 These webs of divisions and groups demonstrate the
complexities and confusion that took place in AAF training facilities right before the war
began.

The sharp increase in personnel and the unexpected U-Boat successes off coastal
waters created a problem of equipping early training facilities for anti-submarine pilots,
specifically for AAF pilots. The United States did not have large numbers of ships or
airplanes to protect the entire Eastern Coast.29 When industries built airplanes and other
machines, the military sent them to the front lines and not to the training programs. This
resulted in the aviators’ unfamiliarity with the technology. President Franklin Roosevelt
wrote to Prime Minister Winston Churchill in May 1942 about the lack of planes for
aircrews. Roosevelt stated, “Today it is evident that under current arrangements the U.S.

27 Air Historical Office, Organization of AAF Training Facilities: 1939-1945. Army Air Force Historical
Studies 53, (June 1946), 13
28 Air Historical Office, Organization of AAF Training Facilities: 1939-1945. Army Air Force Historical
Studies 53, 10.
/docview/106145302/139DA2FFDB326E557CB/1?accountid=15131 (accessed October 18, 2012).
is going to have increasingly trained air personnel in excess of combat planes in sight for them to use.”

General Arnold, of the Army Air Force, described that when facilities did not have the equipment to train their students, the instructors “were somewhat in the position of a man teaching another to swim by showing him a glass of water…” During this time, training facilities had problems with providing the necessary equipment to give their pilots a realistic experience before they left for war.

Even in early 1943, training areas still had trouble with giving their students proper instruction in anti-submarine tactics and techniques. The monthly intelligence report for the Army Air Force Antisubmarine Command gave details on this situation. “Too often badly needed training is delayed because a lack of equipment which should be provided but which cannot be obtained without considerable delay.” In one case training squadrons had to use sunken ships or floating trailers for bomb training. One reason for this disorganization deals with the divide between the Navy and Army Air Force’s jurisdiction before the war.

Before the Second World War pilots did not have experience in basic skills essential in the Atlantic. The responsibilities of each branch determined the training pilots received. The Navy accepted the burden of protecting and attacking targets in the water while the Army focused on engaging targets over land. When the Navy called upon the help of the Army Air Force to protect the American coasts, the Army worked outside its

31 H.H. Arnold, 313.
element. The Army Air Force did not even have a group specifically assigned for attacking submersibles until the United States asked them to help.

After the attack on Pearl Harbor, the unprepared I Bomber Command, started to protect the American coast.\textsuperscript{34} In the first volume of “The Army Air Forces in World War II,” the authors write, “It is hardly surprising, then, that Army planes at first flew in search of U-Boats armed with demolition bombs instead of depth bombs and manned by crews who were ill trained in naval identification or in the techniques of attacking submersible targets.”\textsuperscript{35} The pilots who had the equipment useful in attacking submersibles primarily trained in bombing operations instead of in anti-submarine warfare.\textsuperscript{36} These men needed both the proper teaching and the necessary experience to operate effectively. It is no surprise that the German submersibles caused so much havoc on the American Eastern shoreline. Fortunately AAF pilots received extensive flight training that taught them the ins and outs of their aircraft.

Trainee pilots went through a twelve-week program before they moved on to more specific flying classes based on their future operations. The first stage comprised of both ground and air instructions. Ground instructions contained training in: tactical orientation, military training, indoctrination and familiarization, airplane and engine maintenance, signal communications, armament, instruments, link trainer, meteorology, dead reckoning navigation, and chemical. Classes lasted 168 hours total. For air instructions, the classes consisted of training in: familiarization and transition, individual navigation, formation, night flying, and instrument flying. These classes lasted for 48

\textsuperscript{34} Office of Air Force History, \textit{The Army Air Forces in World War II}, vol. 1, 523.  
\textsuperscript{35} Office of Air Force History, \textit{The Army Air Forces in World War II}, vol. 1, 524.  
\textsuperscript{36} Office of Air Force History, \textit{The Army Air Forces in World War II}, vol. 1, 522.
The specialized training after this program did not include patrol bombing since the AAF never figured they had to operate in the Atlantic. Compared to the Civil Air Patrol pilots, AAF pilots had better training and abilities for anti-submarine warfare.

The Civil Air Patrol, like the AAF, did not expect to take such an important role in the Battle of the Atlantic. Before these planes flew armed, the Civil Air Patrol pilots successfully scared the U-Boats into submerging. The moment these pilots started to bring weapons on their plane, they patrolled as a submarine attacker. In analyzing Civil Air Patrol pilots as submarine attackers, their lack of proper training explained the failure of these pilots to sink the U-Boats. Training had little to do with making a submersible hide and wait below the water. It is true that when a U-Boat operated below the surface they moved so slow that a merchant vessel could outrun their attacker. The submersible would still be operational and it could also sink more merchant vessels once the plane flew away.

For roughly a year the Civil Air Patrol protected cargo ships against U-Boats, but these pilots did little to destroy the enemy submersibles. The CAP contained thousands of workers in this organization and their pilots flew tens of thousand of hours. Unfortunately, CAP pilots failed to give the German U-Boats a reason to retreat. One source does not even credit the Civil Air Patrol pilots with a single kill. Several reasons explain this statistic. Lack of equipment, technology and also training could all be attributed to the poor performance in destroying submersibles. Samuel Morison writes

about how veterans of the First World War serving as CAP pilots in 1942 did not know how to use the instruments for flying. Inexperience attributed pilots’ struggle in anti-submarine warfare. Some of these aviators trained in World War I and some had hundreds of flying hours under their belt. However, compared to military pilots, CAP veterans had little impact in sinking U-Boats. Lack of training and experience hindered the effectiveness of CAP pilots.

Anti-submarine pilots needed hands on experience to find and fix some of the problems encountered on patrol missions, which U.S. pilots failed to have at the beginning of the war. Early training left out certain methods of anti-submarine tactics, because pilots did not discover all the problems of patrolling the Atlantic. As the aircrews flew on more and more missions, anti-submarine units improved. In early bombings of German U-Boats, Army Air Force pilots killed many marine animals. Aviators at times, mixed up the water disruption of a shark with a submersible periscope. These mistakes can be attributed to a lack of knowledge in what the U-Boats look like, and on the aircrews’ lack of patience during coastal patrols.

Patrolling any body of water for submersibles during World War II consisted of both sailors and airmen searching for hundreds of hours without spotting anything useful. Morison wrote how the people patrolling the Atlantic grew more and more anxious. They spotted a U-Boat in every wave they saw or heard. Also, when a German submersible escaped an attack, pilots grew impatient and moved on to search different parts of the Atlantic. They later found out that they could leave and come back soon after and the U-

Boat resurfaced. From these examples, experience formed an aspect of training. In this regard training and subsequent improvement developed over time. The novice level of the pilots in operational missions becomes a reason why aviators failed in the first few months of the war to protect the United States war machine. Proper experience consisted of better techniques, but also more advanced technologies.

The difference in technology hurt pilots in anti-submarine missions. In the first few months of the war, aviators slowly advanced their proficiency in the new forms of detection and attacking technologies. The pilots in anti-submarine operations learned these varying technologies to defeat the U-Boats. Also with the incorporation of new ways to find and sink U-Boats, every pilot needed to learn how to properly use them.

Every soldier in ocean operations understood the importance in developing technologies to track their enemy. Throughout World War II, militaries installed technologies, such as radar, in countless ships and planes. Radar sends a series of electronic pulses and a monitor displays an icon based on the signals that bounce back. Radar allowed aircrews to locate nearby U-Boats at any time of day. This became extremely important in the aircraft’s ability to spot German submersibles at night, a time where U-Boats could hide themselves from detection. The British forces, before America’s entry into World War II, first used radar. Their development and training with this new technology enabled them to make an impact in both the Battle of Britain and the Battle of the Atlantic.

Pilots needed to train in the proper operation of this equipment to find any submersibles. Aviators had trouble with radar in 1942 when planes started to receive this

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44 The Aviation History Unit, 376.
technology. Admiral Doenitz analyzed the use of radar against his own forces. Through experience, U-Boat crews realized that staying close to convoys confused Allied aviators since they were “unable with their locating gear to tell the difference between their own ships and our U-Boats.” Aircrews additionally needed to sink a U-Boat once they found them.

Success in anti-submarine warfare required pilots to learn attacking technologies to defeat the U-Boat. These weapons in the end destroyed the German submersible. The military used depth charges as a common way to sink a submersible. A depth charge is a bomb that explodes once it has reached a certain distance underwater. In the first year of World War II, America pilots used depth charges as a key method of attacking a submersible. After the First World War, the United States thought that their methods of destroying a U-Boat in 1918 would still effectively sink a submersible over twenty years later.

Due to the underdeveloped depth charge and the lack of proper bombsights to accurately drop them, the pilots did little to damage the U-Boats for most of 1942. The process of dropping a depth charge consisted of using a “seaman’s eye” to accurately release their armament. Aircrews estimated the location of a submerged U-Boat based on the speed of the submersible and the speed of their aircraft. Aviators had trouble doing much damage to German submersibles because they could not see the U-Boat they attacked and they inaccurately assumed where the submersible operated. Due to the basic

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nature of the weapon, aircrews needed to use their expertise on the accurate use of depth charges.

Pilots needed training in order to assess the right spot to drop their depth charges. Charles Sternhell’s “Antisubmarine Warfare in World War II,” describes the importance of training in bombing accuracy. In this book, Sternhell shows how pilots who dropped more than ten practice bombs the month before, had sixty-five percent of their attacks categorized as good and only fifteen percent as poor. Pilots who dropped less than ten practice bombs had fifty-one percent of their attacks classified as good and thirty-six percent as poor. In 1942 aircrews only started to use these technologies, and many others, to sink U-Boats. These pilots had little experienced in the use detection and attacking systems like radar and depth charges. Only after months of practice did aviators start damaging the German submersible consistently.

In conclusion, in the first half of 1942 the situation in the Atlantic reached a new low. Even though America worked to improve the effectiveness of coastal patrols once they realized their weaknesses, the U-Boat still put America’s shoreline in to chaos up until August 1942. The Germans decimated America’s merchant ships with only a few ships of their own. In January 1942, the Germans had ninety-one operational U-Boats. Of those ninety-one, only a minute amount of submersibles operated on the American shoreline. Despite the fact that the Germans built more and more submersibles to use against the Allies throughout the war, they never sank as many cargo ships off the American coast as they did in the first six months of 1942. The U-Boats massacred

Allied shipping for the majority of 1942, despite the fact that they had a limited amount of operational U-Boats. This is because the Allied forces, specifically aircrews, failed to give Admiral Doenitz a good reason to retreat. In 1942, only four percent of American airplane attacks did lethal damage to the U-Boat.\textsuperscript{50} German U-Boats significantly damaged American shipping vessels, with little loss on their own side because the United States failed to have trained and experienced pilots taking part in anti-submarine warfare.

Due to the United States’ obligation to protect both their East and West coasts, the United States Navy ordered many trained aviators to the Pacific theater. When Germany began Operation Drumbeat, the current Naval forces did not have the strength to protect American shipping. Instead of having Naval aircrews, which prepared for patrol missions, the United States received improvised aid from the Army Air Force and Civil Air Patrol.

The Army Air Force unexpectedly joined the Battle of the Atlantic. This force had a responsibility to protect the American mainland. With the Naval aircrews separated between oceans, the AAF sent pilots to the Atlantic. These men had no previous training in patrols over water nor did they receive the necessary training once they operated off the American coastline. AAF pilots trained primarily in bombardment, making techniques in anti-submarine warfare a secondary importance. Although the training in the AAF suffered, their curriculum surpassed that of the civilian forces known as the CAP.

As the Civil Air Patrol joined the AAF in patrolling the Atlantic, these pilots needed more training in flying and navigation. The men chosen to fly failed to meet the qualifications that permitted them to join the United States’ armed forces. Thus, when

\textsuperscript{50} Army Air Forces Antisubmarine Command, \textit{March 1943: Monthly Intelligence Report}, 17.
they volunteered to patrol the Atlantic to support the Army and Navy, CAP pilots struggled to do any damage to the German submersibles. They needed proper training, in the tactics and technologies of anti-submarine warfare.

In the first months of the Battle of the Atlantic, the United States’ air forces incorrectly implemented the technologies at their disposal. Radar only just reached a level where it could be used on an aircraft. Depth charges changed little from the First World War and the American pilots needed a bombsight to drop them accurately. All too often, aircrews eyeballed the distance of a U-Boat and guessed the right time to drop a bomb. Pilots needed experience in attacking submersibles to effectively damage a U-Boat.

Finally, aircrews not only needed experience in detecting and attacking technologies but training in anti-submarine warfare in general. The Allies needed crews ready for the hours of mind numbing flight where aircrews looked into the vast ocean, for any ripples in the water or a surfaced U-Boat. At that time the plane only had seconds to make an attack before the submersible submerges. All of these failures provoked the United States into trying an alternate method in an effort to improve aircrews. As a result, civilian scientists joined the U.S. military to analyze these inadequacies of aircrews.
We have seen in the previous chapter that American aircrews had immense trouble in surprising Admiral Doenitz’s U-Boats. Now we will look at who solved the complications that plagued the American forces, both civilian and military, that patrolled the coast. The fiasco for Allied forces, known as the “Second Happy Time” by the German commanders, did such incredible damage to Allied shipping that the United States Government scrambled to find answers. How could U-Boats sink this many merchant vessels? Why were aircrews ineffective at protecting Allied cargo? What needed to be changed for military personnel to have a greater impact on German strategy? Civilian scientists worked to explain these problems.

The Navy took the initiative in utilizing civilian analysts in anti-submarine warfare. Admiral Ernest King, of the United States Navy, instituted the Antisubmarine Warfare Unit to study the German U-Boats and possible defenses. Looking back, these scientists that specialized in operational analysis improved the training and experiences of American aircrews. They not only worked on the creation of new technologies, but also the proper uses of the technologies.

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1 For this chapter I relied heavily on material that the operations researchers published. Their books outlined the problems they discovered and the subsequent solutions. I also sited the Army Air Force Antisubmarine Command’s intelligence reports as a way to explain their conclusions. Operations research groups published many of their findings in those monthly reports in order to communicate with individual officers on new techniques in fighting. I then found the articles by Philip Morse, the father of American operations research, incredibly helpful since he outlined the history of the unit and how they helped the war effort.

techniques and tactics in anti-submarine operations. Since the production of new technologies did little by itself to help in training Allied aviators, I will focus on how analysts found more efficient ways of using existing resources. Operational analysts implemented a relatively unused art to fix the anti-submarine mess.

Before this crisis in the Atlantic, adjustments made from scientific research aided other situations in the 20th century.

In the United States, operations research, specifically in the Navy, existed for many years before the Second World War. Some of the few attempts to use scientists in military operations occurred in 1906 and from 1917-1918, for air combat and anti-submarine operations respectively. During the Second World War, operational analysis showed off its potential in Great Britain early in World War II. The successful assistance by scientists influenced the Allies to take advantage of their intellectual citizenry.

After German forces started to attack Great Britain on her own land, the future of the Allied forces looked bleak. Great Britain raced to find anything to give them the advantage in the war. Once France fell in 1940, Germany increased its attacks on Great Britain. The new Axis objective, where the German Luftwaffe tried to obtain air superiority and compromise the morale of the British people evolved into the famous Battle of Britain. Over several months, German airplanes bombed major cities in England to make the pending Nazi invasion successful. In this battle, Germany had the advantage of numbers, location and time of attack.

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As the aggressor in the battle, the Luftwaffe chose where they wanted to bomb, putting the British pilots on the defensive. Along these lines, the German pilots also decided when to attack, forcing British pilots to remain vigilant at all hours of the day. Finally, due to the fact that the Luftwaffe contained more pilots than the RAF, German forces could swarm any defending plane.

During the Battle of Britain, the British military discovered the advantages of operational research. British scientists improved techniques in intercepting enemy aircraft. P.M.S. Blackett, a professor at the University of Manchester, and known as the father of operations research, wrote how once he started to help the RAF that, “Relatively too much scientific effort has been expended hitherto in the production of new devices and too little in the proper use of what we have got.”

Great Britain focused too much on developing new weapons that they overlooked how they could improve their current weapons. After Blackett’s realization, more effort in mastering current resources occurred. In the early years of the Battle of the Atlantic, operational researchers in Britain analyzed search methods to account for their lack of submersibles spotted. American scientists, after visiting England, accepted and adopted operational research as a key reason for Britain’s

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victory in the Battle of Britain. America soon followed Great Britain’s footsteps and created a scientific division of their own.

Throughout the war, America created several groups that used scientists to help the war effort. Some of these divisions worked specifically on anti-submarine warfare. The establishment of the National Defense Research Committee (NDRC), in June 1940, organized scientists and researchers to aide in the extensive operations conducted by American forces before and after Pearl Harbor. They defined their scope of activities as

…concerned with scientific research on and development of new instrumentalities or materials of war, or of new materials or methods to be used primarily in the manufacture of instruments of war; and of the improvement of existing instrumentalities or materials of war, or of existing material or methods to be used primarily in the manufacture of instruments of war.

The NDRC took the first steps in improving how servicemen use their weapons in the Second World War.

This committee worked with both the Navy and the Army Air Force to improve their technologies. When it came to Naval operations, the Antisubmarine Warfare Operations Research Group (ASWORG), a division of the NDRC, helped to solve any problem associated with German U-Boats. This included the development of technologies but also, following Blackett’s previous epiphany on the definition of Operational research, to improve how seaman and aviators used these weapons, The operations research division of the Army Air Force, the Sea

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Search and Attack Development Unit (SADU), operated independently from the NDRC unlike ASWORG. They still worked closely with the NDRC and their operational research divisions. The SADU, created at Langley Field, to study the attacking methods and technology in anti-submarine operations. In the middle of 1942, ASWORG sent field analysts to SADU to help in any way. This move attempted to improve the methods and discoveries of each division. The intercommunication between these two divisions no doubt allowed for new theories to spread, strengthening their analysis. ASWORG grew into one of the primary groups dedicated to implementing scientific methods in the Battle of the Atlantic.

When the German U-Boats began to ravage the American coast from January until September 1942, operational analysis showed its full potential in anti-submarine operations. In March 1942, the United States established the Antisubmarine Warfare Operations Research Group. This group, led by MIT physicist Philip Morse, one of the prominent figures in operations research in America, worked to help the Navy in their current difficulties. Since ASWORG began quite late, compared to the other programs that requested the aid of scientists, Morse had a more difficult task in recruiting fellow colleagues. Once Morse assembled his team, they immediately started to work together quite productively because they, “came from similar background and talked the same

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13 Tidman, 38.
language.” These civilian scientists first studied the basic concerns of anti-submarine operations and then they worked to find some solutions.

When it came to anti-submarine warfare, the Antisubmarine Warfare Operations Research Group studied how the U-Boats escaped detection. Morse writes how, “If the submarine is dangerous because it is hard to find, then the process of finding the submarine is an important part of the counteraction.” Of the two forces that spotted a U-Boat, from either a ship or an airplane, ASWORG researched the use of the latter as the way to patrol for a surfaced submersible. Airplanes covered a larger area in less time than their ship counterparts. Aircraft research in anti-submarine operations helped impede U-Boat missions because these submersibles actually spent much time at the surface where it operated at a higher level. German U-Boats moved faster above the water, the fresh air recharged their batteries and improved the morale of their personnel. With the Germans moving above the surface of the water, the Allies had a greater chance of sinking these now vulnerable submersibles. Once ASWORG decided on this specific aspect of anti-submarine operations to focus on, they started to ask the important questions. “How far away could a surfaced submersible be seen? And were they always seen? What percentage of the time were they missed?” The answers to these questions improved the skills of Allied pilots in search and attack missions. Answering these questions was not the only obstacle faced by

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14 Morse, 12
15 Tidman, 36.
16 Morse, 13.
17 Tidman, 37.
18 Morse, 13.
operational researchers. They also needed to prove their worth to their Naval superiors.

The Navy took some time to accept the idea of using civilians to improve military troubles. The Navy did not think that non-military personnel could aid them in Naval operations. Philip Morse commented on these strict policies of the Navy; “To let nonmilitary persons participate in even minor operational decisions was, of course, heretical to many officers, especially those of the Navy…” The Naval work force sent their personnel, qualified in anti-submarine warfare, in operations that did not have them studying the U-Boat war. These men worked on expanding a Navy that had to fight a two-ocean war. This caused a need by the Navy to find intelligent men to conduct research. Also, in early 1942, no other organization had enough people that knew enough about mathematical methods to extract helpful solutions. The Navy thought, once they granted scientists the chance to help, that they would follow along with the Navy’s work ethic. Morse describes this presumption by saying, “I suppose we were expected to file quietly in, to studiously digest all the reports, and once in a while to merge to deliver some oracular pronouncement…”

This feeling of separation between the scientists and the United States Navy extended further when Admiral Francis Low, of the Tenth Fleet, refused to tell the majority of the civilian scientists where some of their information was

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19 Morse, 12.
20 Tidman, 31.
21 United States Naval Academy, 5.
23 Morse, 13.
derived. ASWORG members voiced their opposition to the “Navy’s refusal to make us members of the family.”\textsuperscript{24} It did not take a lot of time for the military to notice the importance of having scientists analyze their field operations, because of the growing failures of American forces. Toward the end of the war Admiral King stated, “Only by continuing vigorous research and development can this country hope to be protected from any potential enemies and maintain the position which it now enjoys in possessing the greatest effective naval fighting force in history.”\textsuperscript{25} Even though the military opposed trusting civilians with classified information, over time the formulas made by scientific researchers showed potential for improvement.

As a method that these civilian scientists took when they started to observe a specific problem in detail they asked, “What course of action will best accomplish my objective?”\textsuperscript{26} Once these analysts started to research a problem in detail, they had to consider the same questions before they proceeded.

a. What objective is to be achieved? b. What different courses of action (alternatives) are available? c. What factors (variables) will contribute to the success or failure of each possible course of action in achieving the objective? d. What yardstick can be used to measure and compare the effectiveness of the different alternatives?\textsuperscript{27}

On the question of the objective, scientists had to discover the right problem to answer. Depending on the question one asks, the statistical evidence can either help or hurt your argument. This focus led to different strategies and

\textsuperscript{24} Morse, 16.
\textsuperscript{26} United States Naval Academy, 9.
\textsuperscript{27} United States Naval Academy, 9.
how researchers analyzed statistical data. For example, the addition of anti-aircraft (AA) guns on British merchant vessels to protect themselves from Axis aircraft demonstrated how certain questions contain different answers. Once cargo crews used AA weapons against the Germans Luftwaffe, operational analysts noticed that cargo ships shot down four percent of attacking airplanes. If operational scientists wanted to study amount of German aircraft destroyed as their objective, then a four percent success rate does not demonstrate that these weapons worked. Logically these civilians would conclude to stop fitting cargo ships with AA guns. Looking deeper in this situation, researchers realized that although only four percent of Axis aircraft crashed in their attacks, ships fitted with these weapons protected themselves more so than those without. Twenty five percent of cargo ships sank when they did not have any protection while only ten percent of cargo ships sank with AA guns. When those researchers viewed the safety of Allied vessels as their objective, the fifteen percent difference showed that even though crews did not sink many airplanes, AA guns should be fitted on more cargo vessels.\(^{28}\) Therefore with this example, the objective achieved and the yardstick used to measure its success discovered the most efficient solution to a given dilemma. Also the other questions asked by scientists usually helped in the decision making of other obstacles.

ASWORG effectively analyzed the issues and answered the questions in anti-submarine operations by sending field agents to study these obstacles first hand. The use of field agents supported the improvement of operations analysis because, “...they would work with the users of new weapons, could apply ideas

\(^{28}\) United States Naval Academy 10.
for new tactics in practice, and could recognize new problems to be transmitted to
the central body for further work.” ASWORG sent field agents to frontiers all
around the United States and abroad. This allowed for analysts to understand the
finer points of anti-submarine warfare. First-hand accounts also helped scientists
discover problems specific to each area. Once U-Boats started to sink significant
numbers of merchant vessels in a certain area, ASWORG sent members there to
conduct research. Two analysts, Arthur Kip and William Shockley visited the
Gulf Sea Frontier a month after that area lost 220,000 gross tons of cargo to four
U-Boats. In November, when the U-Boats moved towards the Mid-Atlantic
Gap, an area in the Northern Atlantic far from any airstrip, ASWORG sent
researchers Maurice Bell and John Pellam to Newfoundland. ASWORG
researchers, once they gained the needed information, started to notice common
problems and later gave their input.

In 1943, ASWORG reported on the failures of aircrews in anti-submarine
attacks during 1942, and more specifically, from July until December. They
realized the extent of the failures made by aircrews patrolling the Atlantic.
Aircrews, ASWORG discovered, that of all the attacks made in 1942, the Navy
only characterized four percent of them lethal. In the last six months of 1942,
patrolling pilots improved their percentage to a feeble five percent. Their report
below explains the reasons behind why pilots failed to sink a lurking U-Boat.
From this data, ASWORG scientists worked on finding different solutions.

29 Stewart, 133.
30 Tidman, 38.
31 Tidman, 39.
ASWORG categorized a majority of the "Reasons for a Failed Attack" on pilot errors. In many of the late attacks (A), analysts stressed the necessity for pilots to camouflage themselves. Also, pilots needed to learn how to properly time their attacks so that they caught a U-Boat before it submerged. For bombing errors, ASWORG explicitly blamed a majority of the failures on training. The March Intelligence Report stated that:

Unquestionably, the greatest opportunity for improvement of the overall results of aircraft attacks on U-Boats lies in this field. And the most important single factor affecting the accuracy of bombing is training. A number of attacks, for instance, failed because of nothing but "buck fever". Bomb bay doors opened too late, firing key switch in wrong position, practice bombs dropped instead of live bombs -- these are errors resulting from lack of sufficient training and experience.

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While these failures occurred, in 1942, operations researchers worked to identify possible solutions.

Operations researchers analyzed the most effective uses of anti-submarine technologies. They examined the use of the famous depth charges. They also analyzed the most effective use of attacking techniques, like the angle and speed of attacks. Finally, they looked at the most efficient use of anti-submarine tactics, which included the proper conduct of patrols and proper search patterns. Operational analysts cut the time that normal trial and error took in finding overall problems in anti-submarine performances. This allowed training procedures and subsequently, the aircrews still in school to improve faster.

The technologies implemented by the Navy and Army Air Forces, grew in complexity for aviators to operate. The operation analysts worked to explain how aircrews should handle these devices. The constant development of newer detecting and attacking technologies helped sink more U-Boats if the pilots effectively used them. Scientists, therefore, had the responsibility to make these weapons more productive. The weapon aircrews used depth charges to attack a submersible in the first couple years of World War II. Of the most common mistakes made in anti-submarine operation aircrews incorrectly set the range of their depth.

In the first half of 1942, airplanes dropped depth charges that exploded fifty to seventy-five feet below the surface. This setting could be lethal if the submersible was at that depth as well. Allied destroyers set their depth charges at a range of seventy-five feet. This allowed for the destroyer to reach a safe
distance before their bomb exploded. Also, a stalking U-Boat moved below the surface making a depth charge at seventy-five feet quite dangerous.\textsuperscript{35} The deeper depth caused problems for aircraft, mainly because once a submersible reached this target distance of seventy-five feet underwater the water camouflaged them from their attackers. Aircrews’ accuracy in their attack run depended on their ability to see the U-Boat. At a level where an aircrew made visual contact with a submersible only a twenty-five foot depth charge could explode at a lethal distance. Operational researchers concluded that the fifty-foot settings of the depth charges caused attacks made between July and December 1942 to have only a three percent effect.\textsuperscript{36} Morse comments on this change of depth charge settings, “‘Within two months it was apparent that this change had increased the number of attacks by a factor of about five.’”\textsuperscript{37}

Even if the Allied aircrews set their depth charges correctly, they still had a problem in the aiming of these weapons. Pilots made two errors in submersible attacks: line and range errors. Line errors resulted from the steadiness of the plane while range errors have to do with the timing of the bomb drop. During an attack when the bombs miss their target, The Antisubmarine Command, in charge of anti-submarine warfare, discovered three possible reasons. The pilot could have dropped their bomb at the wrong time, the plane could have missed flying over the target, or both.\textsuperscript{38} When it came to line errors, pilots just needed to practice

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\textsuperscript{35} Morse, 14.
\textsuperscript{36} Charles Sternhell and Alan Thorndike, \textit{Antisubmarine Warfare in World War II}, (Washington, D.C., 1946) 137.
\textsuperscript{37} Morse, 14.
\textsuperscript{38} Sternhell and Thorndike, 129.
\end{flushright}
flying in a straight line. For range errors, scientists saw that pilots missed their targets in greater distances than in line errors.

They found out that in missions over water, aircrews incorrectly estimated the lead needed to drop a depth charge. The Antisubmarine Command told their bombers to drop their charges twenty feet in front of a U-Boat so that once the charge reached its set distance underwater the U-Boat moved in to lethal range. Bombers flying over water ended up dropping their bombs sixty feet in front of their target. Operational researchers looked at this mistake and concluded that more training in water based bombing would fix this problem. In the case of range errors, practice improved pilots, but also trainers had to specifically tell aircrews to compensate their lead because they falsely believed their lead would sink a target U-Boat. Once these weapons dropped on top of their targets, with a proper depth set, these weapons successfully damaged or sank a submersible. Pilots just needed to find a submersible on the surface to show off the lethality of their improved attack.

Aircrews also learned the necessary skill of catching a U-Boat on the water, a vulnerable position for the German crew. Too often the lookout towers on German submersibles saw an incoming airplane and had enough to time hide in the safety of the Ocean. Analysts commented on the tardiness of these attacks and weighed in on ways to fix the problem. Pilots had to learn was how to hide themselves from their prey, as a technique to surprise a U-Boat.

As explained earlier, a fully submerged submersible had several directions to move in order to dodge any weapon. Therefore the pilots also had to spot the submersible first. In the fall of 1941, English analysts discovered that at least sixty percent of U-Boats had already seen an Allied airplane before the same plane spotted the submersible.\textsuperscript{40} Therefore to surprise their target U-Boat, aircrews not only had to stay hidden from possible U-Boats but they also needed to be the first one to spot their target.

In order to catch a U-Boat, pilots had to find a submersible earlier in their search. This allowed for pilots to line up with their target and make an effective attack run while the submersible sailed through the water unsuspectingly. Operational analysts commented on was how aircrews could find a U-Boat faster than before. Researchers established a technique in which height proved a powerful variable in searching for submersibles. These scientists worked on the myth of the proper height an aircraft needed fly in order to spot a submersible. Scientists in England found that the higher a plane searched, the more targets an aircrew found. The United States did not immediately listen to this advice because commanders worried that the higher a plane flew, the lower probability the pilot could make a fast and effective attack run. Scientists later worked to disprove this assumption.\textsuperscript{41}

Aircrews also improved a technique to make sure the Germans did not spot their plane before they had enough time to attack. Pilots had to use their

\textsuperscript{41} Waddington, 162.
surroundings for camouflage. In one example, operations analysts wrote how pilots needed to fly in and out of the clouds around them to get a better jump on a submersible. Analysts also discovered that when a plane flew behind the sun, enemy units spotted much more Allied aircraft because of the contrast in color. On the contrary, during night attacks, pilots would dive on a submersible with the help of the moonlight. Surprise attacks allow for aircrews to properly aim their weapons on a submersible. Once a U-Boat fully submerged itself, Allied pilots could only guess to its location. Aircrews only dropped their weapons accurately when they compensated their drop where they expected a U-Boat to move through, at the time of detonation. Therefore the submergence of a target submersible, also known as ‘blind time’ affected the allowance pilots gave on their drop. Operational researchers commented how, “The effect of a long blind time will be especially serious in aircraft attacks since there is no information as to the target’s course and speed except visual estimation…” The use of attacking techniques increased the chance of finding a surfaced U-Boat. Catching a submersible on the surface thus made aircrews incredibly more deadly.

In some cases pilots failed in anti-submarine operations because their strategies ineffectively searched the Atlantic. Pilots used to search for U-Boats in short distances and would leave early after an unsuccessful attack. Civilian scientists worked to find the most statistically efficient pattern for their airplanes.

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42 Sternhell and Thorndike, 128.
46 Sternhell and Thorndike, 128.
This included the amount of area a given plane could search, and how many aircraft a given operation needed to find a surfaced U-Boat.\footnote{Morse, 13.}

A proper search pattern allowed for more sightings and attacks on U-Boats. However, aircrews needed to conduct searches that could find a submersible that escaped below the water. Too often pilots would acknowledge that their attack failed and then they would search the area briefly before flying away. In December 1942 operations analysts wrote about a pilot who dove on a U-Boat too late and in response, flew in a wide circle in cloud cover until the submersible resurfaced.\footnote{Army Air Forces Antisubmarine Command, \textit{December 1942: Monthly Intelligence Report}, December 1942, \url{http://cgsc.contentdm.oclc.org/}, 11.} The success of this sortie credited the aircrews’ tactic, making this method of attack beneficial for many different commands. This improvement helped to make new aircrews more efficient. With the implementation of baiting tactics, pilots had multiple chances to damage their target submersible.

Operations researchers also confirmed ideas held by many experienced pilots. Aviators had a feeling that the closer towards shore a plane searched, the less likely the chance that they would find a submersible. This is because a U-Boat remained submerged for as long as they could once they operated close to any shoreline.\footnote{Sternhell and Thorndike, 140.} This made conducting searches further from base enticing and more common.

Training made aircrews effective in the Atlantic. Operations researchers gave the crucial advice essential for these new pilots. This gave training programs

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\item \footnote{Morse, 13.}
\item \footnote{Army Air Forces Antisubmarine Command, \textit{December 1942: Monthly Intelligence Report}, December 1942, \url{http://cgsc.contentdm.oclc.org/}, 11.}
\item \footnote{Sternhell and Thorndike, 140.}
\end{itemize}
more information to teach their students, finally making them the deadly force the
military expected from them. Once ASWORG members discovered a problem
made by most aircrews, they recommended how to fix it. Training programs then
implemented this correction, making new aviators that much better. William
Shockley, a scientist in ASWORG noticed how aircrews only had, on average,
one opportunity to sink a submersible in their “active life”.\textsuperscript{50} The active life of an
aircrew is the amount of time a crew is together before the military sent them to
other duties, killed or wounded.

Due to the lack of time for each aircrew to improve from their own
experiences, the military need to report any discovery in anti-submarine warfare
to have these techniques and tactics implemented in training. Experience is a great
way to improve any military force. Sadly, because of the short active life of
aircrews, the Army Air Force and the Navy could only benefit as a whole from
the realizations made by pilots instead of the individual aircrews. This is one of
the reasons why civilian scientists impacted anti-submarine training and the skill
of operational aircrews. In the Battle of the Atlantic, tactics and techniques
constantly changed and adapted to give one side a greater advantage. Operations
researchers had to catch the U-Boat as the German Navy started to implement
different strategies and subsequently develop new techniques for their pilots.\textsuperscript{51}
New aviators and those in the field needed to regularly learn new tactics. Training
programs started to improve as the war continued. “…it is now possible for the

\textsuperscript{50} Morse, 17.
\textsuperscript{51} Ernest J. King, 720.
entire crew of a submersible to rehearse approaches and torpedo attacks against enemy task forces in trainers on dry land…”\textsuperscript{52}

In conclusion, after the insurmountable amount of merchant vessels lost in the first several months after Pearl Harbor, the United States Navy needed answers. Although the Navy did not want to work closely with civilian scientists, they realized that these researchers knew how to figure out the solutions necessary to turn the tides in the Battle of the Atlantic. ASWORG, after its creation, analyzed technologies, techniques, and tactics of aircrews. American scientists not only created newer technologies to be fitted on patrol craft but found the proper way to use existing ones. The settings of the old depth charge improved. When it came to techniques, the use of their natural surroundings helped to make their attacks lethal. The tactics of a useful search pattern then allowed for the Allies to spot a U-Boat. As scientists realized each of these new developments, new aircrews benefitted. An aircrew only had one opportunity to sink a U-Boat and because of this, the military made sure new trainees knew all the tricks on their missions.

\textsuperscript{52} Ernest J. King, 718.
CHAPTER FOUR

AN OVERWHELMING IMPROVEMENT:

ALLIED REFORM AND AXIS DEFEAT

After the middle of 1942, America’s effectiveness in the Battle of the Atlantic improved. No longer could German U-Boats scout the United States coastline without worrying about their safety. Even in missions in the North Atlantic, German submersibles preferred to attack a convoy once they moved outside the range of any patrol plane. Improvements in the pilots and the organization command helped America changed the tides of the Battle of the Atlantic. After extensive analysis, aircrews perfected the tactics and techniques of anti-submarine operations, making their attacks more numerous and lethal.

The United States used the advice of the Antisubmarine Warfare Operations Research Group to develop the detecting and attacking aspects of anti-submarine operations. The American military also reformed their command structure to adequately train aircrews for patrolling missions. In this progression, Naval and Army Air Force aviators corrected many of the problems that plagued American aircrews in early 1942.

The Army Air Force realized the need to graduate pilots who had more education. This educational awakening contained both an improvement in the selection of cadets and a correction to the curriculum for pilots. After these changes, the Army Air Force

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1 In this chapter I used several appendices from authors such as Samuel Morison and S.W. Roskill to show the changes in the Battle of the Atlantic over time. I also studied intelligence reports since they graphed many of the statistics of anti-submarine operations. This information allowed me to demonstrate the improve skill of aircrews. Unfortunately since the Army Air Forces did not establish the AAFAC until late 1942, I do not have many statistics of U-Boats attacked and sank during the majority of 1942. Finally, I looked at sources that outlined new commands and divisions created in the Battle of the Atlantic that emphasized training. Groups with a direct objective of training shows a focus on pilot improvement.
accepted men who showed promise in the strains of flying. Also these pilots attended classes that incorporated training in anti-submarine operations.

Reorganization of the commands in charge of training helped to coordinate the methodology and structure of schooling cadets. This reform coupled with the educational corrections established an air force ready to fight the German submersibles. Both the Army and Navy fixed their problems and operated in the Atlantic with great accomplishment.

These solutions made American forces in the Atlantic able to pressure the German submersibles and even make them retreat to safer waters. The aircrews’ abilities to attack a U-Boat and, more importantly, sink the same submersible increased immensely since their early failures in 1942. These successes forced the German commanders to operate in areas away from high merchant traffic or of any military importance. By August 1943 the scene in the Atlantic saw a complete reversal. German U-Boats no longer influenced Allied operations.

The Army restructured their commands with the creation of the Army Air Force Antisubmarine Command (AAFAC). Before this division, the I Bomber Command picked up the slack for the Navy. Sadly, this command primarily operated in bombing missions and not in anti-submarine patrol. With the AAFAC, pilots trained specifically in the skills necessary for anti-submarine warfare. The Navy followed suit and created an anti-submarine warfare unit.

After the German U-Boats moved to the North Atlantic in late 1942 and subsequently sank tons of cargo vessels away from the air umbrella that previously protected them, the United States Navy established a command devoted to patrolling the
Atlantic. The Tenth Fleet organized the operation and training of patrol units, since the Navy increased the amount of pilots ready for combat. A larger pool of pilots allowed for the Navy and AAF to greatly improve on their current cadets. This included a more rigorous entry examination and more developed training.

The United States’ improvements to the organization of training and the specific curriculum for pilots coincided with their growing success in the Atlantic. Now pilots and cadets received accurate and coordinated training that shaped them into a deadly unit. Since both operating pilots and ASWORG scientists at this point identified impressive strategies in response to America’s earlier inexperience in anti-submarine warfare. First the Army Air Force, who conducted a significant amount of patrolling missions, required the selection of capable pilots.

In 1942 the Army Air Force changed the way that they chose possible cadets for training. The Aviation Cadet Qualifying Examination improved the format of the questions. From 1942-1943 the AAF created questions to observe whether or not the student could learn vocabulary and scenarios expected of a pilot. For example, instead of asking a student to find the fourth power of one plus the square root of negative one, the test asks the student to determine how long it would take for two planes of different speeds to reach a certain distance from one another. Due to this new objective the AAF cancelled the need for any education experience. From this selection overhaul, Army Air Force cadets had relevant knowledge for flying missions.

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2 Assistant Chief of Air Staff, Intelligence Historical Division, *Initial Selection of Candidates for Pilot, Bombardier, and Navigator Training*. Army Air Force Historical Studies 2, (November 1943), 9 & 28.

After the Army Air Force found a talented pool of cadets, these new pilots needed more accurate training in anti-submarine warfare. When the AAF realized that they had to patrol the U.S. coast for U-Boats, they implemented a new training program devoted to prepare pilots with this new operation. Pilots trained with the Operational Training Unit for four weeks. This course consisted of “B-24 transition, bombing and gunnery, navigation and practice patrol.” This class analogous with Naval training qualified aircrews for anti-submarine operations. After completing the course, pilots understood many of the technologies and techniques of ASW.

The Army also incorporated an intensive bombing program in 1943. The Antisubmarine Command Training Directive coordinated the tasks during this program as a way to improve the bombing accuracy of anti-submarine pilots. Throughout the training regiment, pilots practice flying in the clouds while using their radar to position themselves for an attack. The pilots then move on to Naval exercises where they sharpen their attacks on a submerging submersible. Colonel Halverson of the 26th Air Wing commented on this form of training: “This kind of training boosts combat crew morale tremendously. Working first with a simulated U-Boat, and finally with an actual submarine, gives each crew member confidence and the feeling that any enemy submarine he meets will never meet another 26th AWIG plane!”

Throughout the training operations, the results are recorded in an effort to allow the pilots to see their attacks and for the operations researchers to analyze them. During the pilots’ practice drops on a target, a tail gunner plots where the bombs landed and also cameras in the plane take pictures of the drop. These pictures helped the pilot see where

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his charges ended up. While these exercises occur, an adjoining plane filmed the attack and the pilot saw the results of the exercise. The Plans and Training Section later received the film for analysis.\(^\text{6}\)

Although all of these corrections in the teaching of new pilots prepared cadets for the complexities of anti-submarine operations, the Army Air Force and the Navy had to also organize their efforts against the U-Boats by creating a command with the sole responsibility of anti-submarine warfare. Throughout 1942, a large variety of forces conducted anti-submarine patrols. Of the forces involved, none had the strength to take control of anti-submarine operations. The Army Air Force started to restructure in the fall of 1942 for an anti-submarine command.

With the I Bomber Command weakened because it had to divide its strength between operating as a bombardment unit and as a patrolling unit, the Army air Force decided to commission a command for protecting American waters from the German submersibles. On 15 October, 1942 the Army Air Forces centralized their anti-submarine patrols and created the Army Air Force Antisubmarine Command (AAFAC). This command followed the British Coastal Command organization, which allowed for a unit to train and prepare solely for these specific operations. Also this command had more freedom to take part in anti-submarine warfare.\(^\text{7}\) Most of the units and equipment of the AAFAC came from the I Bomber Command due to their previous experience.\(^\text{8}\) The AAFAC only enjoyed control in anti-submarine operations for a limited time. Less than a

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\(^\text{8}\) Assistant Chief of Air Staff, Intelligence Historical Division, *The Antisubmarine Command*. Army Air Force Historical Studies 107, (April 1945), 41
year later, the Navy created its own unit for anti-submarine warfare. This change came about after the German U-Boat victories in the North Atlantic.

In 1943 the United States Navy worked to fix any and all problems associated with their organization of anti-submarine operations, including training. After the U-Boats in the North Atlantic started to sink absurd amount of merchant vessels President Roosevelt explained a need for victory in the Battle of the Atlantic. Soon after this statement, the Navy made the final organizational change in regard to the anti-submarine operations. The Navy created this fleet as a specific command devoted to anti-submarine operations, the Tenth Fleet. However, the Army Air Force Anti-submarine Command still operated against the German U-Boats. The Tenth Fleet reintroduced an organizational problem that existed for years. With the Army in charge of the land-based planes and the Navy in charge of the implementation of these planes, how could the United States unify a command devoted to anti-submarine warfare? One side needed to control anti-submarine training and operations to effectively patrol the Atlantic.

The Navy pushed for the Tenth Fleet to have sole jurisdiction in anti-submarine operations and moved to discontinue the aid of other units. In one of the first moves made by the Tenth Fleet, the Navy worked to discontinue the Army’s power in the Atlantic. Specifically, Rear Admiral Low said:

The fact that Army aircraft assigned to antisubmarine operations reported only to the operational control of Sea Frontier Commander, which resulted in the anomalous situation of CominCh being unable to give orders to echelons who were under his juniors because of the Army construction (with which the Navy did not agree) that such a command relationship

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precluded issue of orders to Army A/S aircraft by anyone except the Sea Frontier Commanders and the Army Commanders.\textsuperscript{10}

Little by little the Navy substituted their pilots with the current Army Air Force pilots conducting anti-submarine operations until the Navy had complete control of the Battle of the Atlantic. Finally, in the summer of 1943, the Army Air Force bowed out of the argument and agreed to give the Navy, who historically had responsibility in operations over water, complete control of anti-submarine operations.

At a conference in June 1943, General Arnold agreed to withdraw Army Air Force control in anti-submarine operations once the Navy had the strength to take over. This, along with a trade of anti-submarine fitted aircraft for unmodified B-24s ended the extensive fight over control in anti-submarine operations.\textsuperscript{11} Finally, in August 1943 the Army Air Forces designated the AAFAC back to the I Bomber Command, inactivating their units that patrolled for submersibles.\textsuperscript{12} This made the Tenth Fleet the unit in charge of finishing the Battle of the Atlantic. Now the United States had a command with a centralized training program, cadets received a more unified curriculum.

The Tenth Fleet had no direct attachment with the planes and ships in anti-submarine operations. Instead, the fleet operated through the individual Sea Frontiers and Fleet Commands.\textsuperscript{13} The Commander in Charge of the Navy described the directive for the Tenth Fleet.

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(a) Destruction of enemy submarines.
(b) Protection of Allied shipping in the Eastern, Gulf and Caribbean Sea
   Frontiers.
(c) Support of other Anti-submarine Forces of our own and of the Allied
   Nations operating in the Atlantic Areas.
(d) Exercise of control of convoys and shipping that are U.S.
   responsibilities.
(e) Correlation of U.S. anti-submarine training and material
   development.14

Therefore, the Tenth Fleet became responsible for all operations off the coast of the
United States and further into the Atlantic Ocean. Even though the Commander in Charge
did not list of directives above by importance, the succinct explanation of (a) represents a
significant mission in the Atlantic.

The Navy organized the Tenth Fleet into five divisions. The first, Operations
Division under Captain William Sample, handled the forces assigned to anti-submarine
work and the combat intelligence team that plotted U-Boat locations. The Navy also had
the Convoy and Routing Division under Rear Admiral Metcalf that developed the convoy
system used. The Tenth Fleet also contained a Civilian Scientific Council and the Air
Anti-submarine Development Unit Atlantic Fleet. Finally, the Tenth Fleet organized the
Anti-submarine Measures Division.15

The Anti-submarine Measures Division under Captain Haines, and later Captain
Fitz, correlated “anti-submarine research, materiel development, and training.” In July
1943 the Tenth Fleet absorbed ASWORG making those civilian scientists working with
Phillip Morse report directly to this new group.16 The Tenth Fleet put ASWORG under

May 1943- May 1945, 24.
the leadership of Captain Haines in this division. Similar to the establishment of the Tenth Fleet that consolidated multiple entities into a single body, the Anti-submarine Measures Division integrated ASWORG to better coordinate anti-submarine training.

To specifically describe the goals of the Anti-submarine Measures Division, the Commander in Charge of the Navy stated that the division needed to take steps so that:

(a) each ship and plane is proficient in the basic technique of normal operations both as to personnel and material.
(b) training in the use of sound and special equipment is intensive and sustained.
(c) all units (surface and air) are subjected to regular refresher courses at training centers appropriately organized, staffed and equipped.
(d) training is conducted through the medium of a standardised instructions approved by this Headquarters.

Along with the list of intentions of the Tenth Fleet, the Navy also circulated ways to improve an attack on a U-Boat. In June of 1943 the “U.S. Fleet Anti-submarine Bulletin” summarized different aspects of the anti-submarine war including doctrine and training. This bulletin communicated new developments in anti-submarine operations and training more often than the tactical publications. Thus, officers constantly learned new practices to follow in a battle with regularly changing strategies.

Around the same time that the Navy commissioned the Tenth Fleet, The Navy also established the Aircraft Antisubmarine Development Detachment. This detachment allowed for a more direct connection between the pilots and the civilian scientists. From this correspondence, the Navy discovered the proper ways of conducting anti-submarine

operations. This included finding the best uses of anti-submarine technologies, and developing improved communications for pilots in anti-submarine warfare. This command tested different problems in patrolling missions. Students applied the new techniques of fighting in this detachment.\textsuperscript{20} From this detachment, the Navy learned new tactics that they could forward to the training divisions and operational pilots.

The evolution of the divisions, which managed the aircrews in anti-submarine warfare and their training, built and prepared a competent unit to fight the German submersibles. With a greater understanding into the organization of anti-submarine commands and the specific training regimen pilots received, the role of training demonstrated itself as a valid explanation to the growing success of aircrews in the Atlantic theater. These improvements in the organization of training combined with the advice from operations researchers increased the lethality of anti-submarine aircrews. The developments of the aircrews’ abilities played a part in the statistical achievements displayed towards the end of the Battle of the Atlantic.

All the improvements in the curriculum and organization, strengthened the graduating aircrews of the Navy and Army Air Force. Not only did the Allies’ merchant shipping lanes operate without the slightest fear of damage, but also the Allies sank the German U-Boats so regularly that the submersibles patrolled waters unimportant to the war effort. The Allied aircrews increased the attacks made on a U-Boat, the amount of U-Boats sunk and their lethality. From the alarmingly low statistics on aircrew proficiency in the months after Pearl Harbor, the Allies boosted their prowess in anti-submarine warfare.

An increase in the amount of U-Boats attacked demonstrated an improvement in many different factors. Advancements in technology allowed for aircrews to spot a U-Boat, and the proper implementation of aircrews to bases in the North Atlantic placed aviators closer to the U-Boat’s new areas of operations, but also more developed training helped pilots to properly attack a submersible. Specifically, ASWORG analyzed the best pattern for pilots to spot any patrolling submersible. Also the pilots learned how to fulfill their plane’s capabilities. The aircrews also improved on their abilities to spot a submersible.

The figure below shows the increase in U-Boats attacked from January until August 1943. The graph indicates that Allied aircrews improved on their abilities to attack a patrolling submersible. Undoubtedly, aircrew performance, from training, evoked this change in some respect.

The graph demonstrates the boost in U-Boats attacks in 1943. Allied attacks skyrocketed after February 1943. After May, we see a drop in the number of attacks made, but we also see that the number of U-Boats at sea has decreased as well. On average, from March until May 1943 Admiral Doenitz ordered 115 U-Boats to operate in the Atlantic. After this time the amount of U-Boats in the Atlantic continues to drop until late 1944. Specifically, from June to August 1943 only seventy-six U-Boats patrolled the Atlantic on average. Unfortunately, examples like weather condition, and the slow increase of Allied long-range aircraft, share credit for the increase in attacks on U-Boats.

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22 Porten 248.
Statistics on the amount of U-Boats sunk also show an improvement of aircrews in anti-submarine warfare. As I stated in the beginning of this study, the number of U-Boats lost sheds light on the competence of Allied aircrews. German submersibles, for the most part, submerged once they spotted an airplane. Any convoy of merchant vessels could escape without harm once a U-Boat operated underwater. Only with the destruction of his U-Boat force, could the Allied claim total victory in the Atlantic.

U.S. forces had trouble in sinking U-Boats in the first few months of the war. Until August 1942, the German U-Boats operated around American waters with little danger from aircraft. In August, American planes sunk, or helped to sink four U-Boats. Compared to the months before, only March and July enjoyed the successes of multiple U-Boat kills in a single month. After this month, the U-Boats retreated to operate in the North Atlantic, away from Allied aircraft. When U.S. planes started to move to the North Atlantic, the amount of U-Boats killed grew tremendously. The above graph shows this increase in U-Boats sunk during 1943. The improvements from early 1942, demonstrate the progression of Allied aircrews in the Atlantic. Not only did aircraft make more attacks on U-Boats but also they sunk more in the process.

The lethality of aircraft in the Battle of the Atlantic validated the argument of training and better-prepared aircrews as an aspect in America’s success against the German submersibles. The accomplishment of Allied aircrews in properly coordinated attacks represents the improvements of training in the Atlantic.

When the United States entered the Second World War, American pilots struggled in not only finding a submersible, but also in executing an attack on a U-Boat that

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damages it. The Antisubmarine Warfare Operations Research Group studied the attacked by American pilots and realized the horrible inaccuracies of the pilots. These operations researchers determined that in 1942 that aircraft lethally damaged a U-Boat four percent of the time. After analysis on those failures and the organizational reform of the Navy and Army Air Forces did the lethality of pilots rise. The graph below shows the effectiveness of air attacks on U-Boats in 1943. The axis on the left represents the amount of merchant vessels sunk for every U-Boat sunk. The axis on the right represents the amount of U-Boats sunk per attack made by the Allies.

![Chart showing efficiency of attacks by U-Boats and against U-Boats.](image)

Compared to the four percent chance of a U-Boat sinking after an attack, the Allies increased their efficiency in 1943. Despite poor weather and a change of temporary

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change in tactics by the German commanders, pilots never reached the low levels of
accuracy of 1942. The graph shows the lethality of the Allies reaching as high as twenty-
nine percent. ASWORG analysts wrote that the percentage increase of U-Boats sunk per
attack, demonstrated the success of training and experience in anti-submarine warfare.25

In 1943, aircrew abilities reached a high level in the Atlantic. No longer did
German U-Boats patrol merchant lanes as they did a year prior. With an increase in the
number of pilots, the United States Navy reestablished themselves as the only force in the
Atlantic. The Tenth Fleet unified anti-submarine training and operations and the Army
Air Force designated their anti-submarine forces back to their original roles as bombers.
Also, after months of analysis and experience in anti-submarine warfare, aircrews knew
the best tactics and techniques to fight the U-Boat. All of these factors came together to
make a strong Navy and Army Air Force.

In 1942, American aircrews reported an inadequate four percent in attacks the
Navy assessed as lethal. In 1943 this number rose exponentially. Allied aircraft pushed
the German U-Boats from the British coast, the American coast and even in the mid-
Atlantic gap, out of range from most aircraft. Finally the Battle in the Atlantic ceased to
be relevant. Well-trained American aircrews defeated the U-Boat menace of 1942,
allowing for the Allies to focus on advancing instead of defending. Even though
American troops still had a lot of fighting left before the Axis surrender, the successes in
the Atlantic roughly marked an end of the beginning in the Second World War.

25 Army Air Forces Antisubmarine Command, August 1943: Monthly Intelligence Report, August 1943,
CONCLUSION

In the Battle of the Atlantic, training showcased its importance in turning the tides against the German submersibles. Properly trained aircrews in anti-submarine warfare reinforced the urgency to not only develop modern technology, but also to prepare aviators and seamen to fight the U-Boats. Accurate training combined with advances of anti-submarine weapons, proper implementation of resources and many other reasons, as an explanation for the American victory in the Atlantic.

This Independent Study looked at the human element in the Battle of the Atlantic. Warfare in the twentieth century contained more advanced machinery than in any previous conflict. Countries relied heavily on technological developments to demonstrate their strength. However, the soldiers, like the technology, had to improve. In a sense, learning the technologies became more pivotal than its creation. Additionally, parallel to technological upgrades, more sophisticated tactics emerged, especially in the Atlantic. Pilots needed to master difficult attacking techniques to successfully destroy a U-Boat.

This thesis examined the role of training for American pilots in the Battle of the Atlantic. When other authors described pilot training in the Battle of the Atlantic they wrote about other aspects of the battle as well. Other prominent authors described technological upgrades, intelligence superiority, and anti-submarine strategies as reasons for the Allied victory in the Atlantic. All of the arguments above rightfully explained causes for the destruction of the U-Boat, however in this study I focused only on one aspect, in order to get a more detailed look at the battle, training. This paper spotlighted the training aspect of the Battle of the Atlantic including the training regiment of
American aircrews. This allowed for a more detailed look at one of the many reasons why America’s effectiveness in the Second World War improved over time.

In the Battle of the Atlantic, exceedingly difficult operations demonstrated the need for trained aircrews. Atlantic patrols involved hours of looking and waiting in the hopes of catching a stalking U-Boat. When aircrews spotted a submersible they had only seconds to move into position and attack before the U-Boat fled. Thus aircrews needed training to improve their attacks on submersibles.

Since American aircrews lacked proper training in anti-submarine warfare, German U-Boats enjoyed relative ease in obtaining their objective of economic disruption. The German objective, equivalent to the First World War, focused on destruction of Allied merchant cargo to cut off valuable resources to the Allies. The Allies, on the other hand, concentrated on protecting their ships and sinking the German submersibles to enable a well-supplied invasion of Europe. When America joined the battle, the German U-Boats sank tons of merchant cargo. Training, coupled with other reasons caused America’s inability to fight against the German onslaught.

The defending aircrews never trained in or had experience in the complexities of anti-submarine warfare. Since most of the Naval aviators trained in patrolling the Atlantic Ocean left for the Pacific theater, the United States had to elicit help from forces unready for this kind of warfare. The Army Air Force had jurisdiction over the American continent and therefore they never expected to operate in anti-submarine missions. The Civil Air Patrol joined the Army Air Force and they also struggled in patrol missions because CAP pilots lacked the training of anti-submarine operations.
In some cases, even the most accurate training at the time left operating aircrews unprepared because America never experienced anti-submarine warfare. Once pilots in the field learned effective techniques after trial and error, classes taught cadets new breakthroughs. While pilots slowly discovered more effective ways of fighting, the German U-Boats succeeded in destroying merchant vessels.

Next, due to the unexpectedly early entrance in the Second World War, the United States military did not organize their commands efficiently. The Army Air Forces decentralized their command structure making it more difficult for officers to coordinate pilot training. The Navy, like the Army Air Force, also needed to reform its structure. Indirect communication that passed through a commandant who had little knowledge in aviation hampered the Navy’s ability to operate at a high level.

The United States reluctantly took advantage of the untapped pool of intellectuals as a way to improve their understanding of anti-submarine warfare and subsequently their training. The Navy wanted to know the reasons why American pilots failed to sink the German U-Boats. Even though the Navy unenthusiastically shared their information with civilian scientists, these analysts proved their worth in finding solutions to pilot errors.

Operations researchers recognized the importance of properly using the resources currently available. These scientists analyzed the mistakes made by aircrews and instituted more improved techniques. In one example, scientists examined how to properly use the technologies at their disposal, which cadets and operational aircrews soon learned. With the example of depth charges, setting them to a shorter distance allowed for an increase of damage to a target U-Boat. Along with improvements of
technology, civilian analysts fixed how pilots searched and attacked German submersibles.

Improvements in the tactics and techniques of aircrews in anti-submarine operations enhanced the effectiveness of American forces. Due to the research of scientific groups like the Antisubmarine Operations Research Group, cadets trained in techniques like camouflage to surprise a U-Boat. They also learned more specific search patterns to increase their chances of finding a patrolling submersible.

In 1943, with the help of more adequate training, Allied pilots attacked more U-Boats, sank more U-Boats and increased the lethal percentage of their attacks. American aviators conducted patrol missions at a higher proficiency in 1943 than in 1942 because they had more satisfactory training in anti-submarine warfare. The spring of 1943 marked a permanent change in the Battle of the Atlantic. After an abysmal month in March, where German U-Boats destroyed thousands of tons of cargo, Allied forces sank a significant number of submersibles. From May 1943 until the end of the war, the German submersibles struggled to make an impact on Allied shipping.

The Battle of the Atlantic, in the context of the entire war, represented one of the main obstacles before the invasion of Europe. The retreat of Admiral Doenitz’s U-Boat army not only demonstrated the importance of well-trained aviators but it allowed for Allied ground forces to advance against the Axis powers. The opening of sea-lanes in the Atlantic permitted the transportation of troops and equipment to England to prepare for the invasion of Europe.  

1 Secondly, the enormous amount of ships, planes, funds, and overall effort associated in anti-submarine warfare soon helped other operations, like the

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1 Richard Hough, 306.
impending attack on France.\textsuperscript{2} Training may not have won the Battle of the Atlantic single-handedly, but without the improvement of pilots, who conducted Atlantic patrols, the Germans would have enjoyed a more one-sided battle.

Annotated Bibliography

Primary Sources


This article comments on the use of civilian pilots to help the Navy and the Army Air Force in patrolling the Atlantic Coast of the United States. It gives information on the effectiveness of these new pilots. These civilians scared the German U-Boats into submerging. This retreat allowed for many merchant vessels to safely reach their destination. This article helps me argue that training was not necessary in saving Allied cargo ships during the war. It can be argued that technology had little affect on saving ships because these civilian pilots were helping patrol the coastline with civilian planes. I will use this document when I differentiate between the destruction of the U-Boats in the Atlantic to the amount of cargo that was sunk during the war.


This report, created by the Army Air Force Submarine Command, analyzes significant changes in Anti-submarine operations throughout the Atlantic Ocean. This document received its raw data from top-secret sources and all combat crews and their organizations are allowed to read this report. This summary explains one of the most damaging months against the allies in the Battle of the Atlantic. This intelligence report describes the submersible situation in November and the previous months. In these reports there are operational records of Allied aircraft, theories of German strategies and stories of attacks on submersibles, including the successes and failures of these strikes. For my I.S. I will use this document to explain the situation the allies were in at the end of 1942. It was during this time that the U-Boats were giving Allied shipping the most trouble. These months caused President Roosevelt and Prime Minister Churchill to give top priority to the Battle of the Atlantic. Although this summary is not as extensive as the intelligence reports in 1943, there is still useful information. One of the chapters writes about individual stories of attacks on submersibles. These reports are described to tell pilots what has worked and what has not when attacking U-Boats. The topics described are the use of camouflage, the distance before attacking and the height of an attack.


This document follows November in the description of anti-submarine operations in the Atlantic. Like the other months, I will use the statistics provided in this report to show the reader the progresses made in anti-submarine warfare. This
month is specifically useful in my I.S. because it talks about the commission of the 18th squadron. This unit was created for operational training. This squadron trained aircrews in the initial aspects of anti-submarine operations. This document describes the need for a training squadron because commanding officers had to waste time in helping their pilots learn the basics of attacking U-Boats. This does not mean that pilots were not expected to learn on the job. This chapter goes on to tell commanding officers that they need to keep up to date with changes in attacking that are more efficient.


The January Monthly Summary looks at the sinking of merchant ships, offensive tactics, defensive tactics, the use of aircraft, and new technologies during the month. From these observations, the report explains any possible reasons for shifts in statistics from the previous month. This primary source allows me to examine anti-submarine operations before the spring offensive in 1943. It is essential to see how the Submarine Command viewed the role of aircraft and training when it seemed like the U-Boats were almost nonexistent in the Atlantic. It was during this time that Admiral Doenitz ordered most of his U-Boats to come home to repair and rearm. This source is useful in my I.S. for many reasons. First, the monthly summary states that the Submarine Command realized how important aircraft are in the protection of convoys. Land based aircraft were able to protect American coastal waters effectively, which forced the U-Boats to operate in the mid-Atlantic. Finally, this source describes new technologies developed for aircrews to find and sink a spotted submersible. In the explanations for the proper use of these technologies it is obvious that the operator must be well trained in the use of this equipment.


This report by the Army Air Force Submarine Command analyzes the increase in U-Boat attacks during the month of February. In January, the Mid-Atlantic Gap region lost 2 merchant ships to U-Boats totaling a little of 20,000 tons. In February the same area lost 31 merchant ships totaling nearly 200,000 tons. This report is very useful in my I.S. since this document talks about the importance of training in sinking of submersibles. Specifically, this source states that to increase the amount of U-Boats sunk, the Submersible Command needs more long range aircraft, improved technology, and improved technique. The improved technique can be reached by an increase in training. The report goes on to give an example of bombing errors by pilots when a submersible is spotted. The bomb itself is lethal; the problem is that it is dropped too far from the submersible to be effective. This issue can be fixed by having more experienced pilots, either with more missions flown, or proper training. The document goes on to quote the commanding officer of the 26th Anti-submarine Squadron on training when he said, “This kind of training boosts combat crew morale tremendously.” Finally,
the Intelligence Report describes the training facilities in use. The training facilities are improperly supplied to provide their crews with realistic targets. This caused a delay in training for most stations. Some even had to revert to using a trailer as a target.


This primary source summarizes anti-submarine operations during the last effective month of U-Boat operations against Allied merchant vessels in the Battle of the Atlantic. It is in this month that people started to worry about the current strategy and the German U-Boats. Oddly enough, the month of March was not the worst month for the Allies. May, June and November of 1942 lost more tonnage than in March 1943. The Allied worry came from the fact that in January 1943 the amount of supplies lost were less than at any point in 1942. This report is key in my I.S. since it describes the problems of poorly trained aviators. Also these planes needed to be able to properly detect and attack a German submersible. Flying a plane over the U-Boat would hinder an attack on an Allied convoy, but it would be the destruction of the U-Boats that would cause Doenitz to rethink his entire operation. Specifically this detailed report explains that 41% of aircraft attacks fail to even hit the U-Boats, while only 5% of attacks will sink one. Most importantly, this report has a four-page chapter on why recent attacks on U-Boats failed. There are many reasons why attacks failed, but a large amount of errors were noted as preventable if there was proper training. These examples include bombing errors, attack time, and coordination.


This primary source looks at the anti-submarine campaign in the Atlantic during April. During this month, merchant vessels lost decreased significantly. In March we saw an extreme amount of lost cargo in the Atlantic, while in April cargo ships were more protected. During this time we see the use of an ‘Air Umbrella’ in the Atlantic. This strategy has air covering Atlantic convoys through their entire trip to England. This source specifically talks about the growing use of hunter-killer groups. These groups of aircraft do not treat the convoy as bait, waiting for a U-Boat to attack. They instead, fly to areas of high submersible concentrations and look to sink them. The theory of this strategy is that if less U-Boats are in the Atlantic there would be less merchant vessels sunk. This report is useful in my I.S. because it allows me to follow the statistics regarding the submersible war in 1943. Of these numbers, I will use the amount of merchant vessels sunk, U-Boats spotted, and U-Boats sunk during this month.
Following the pattern, this report analyzes the anti-submarine campaign in May. May is a very important month when looking at the Battle of the Atlantic. It was during this time that Allied forces were consistently sinking German U-Boats. In May Allied aircraft made 193 attacks on U-Boats, much more than the 133 in April. When looking at the statistics, the amount of U-Boats successfully attacked in March is not much different than in May. The significant fact is that in March most of the attacks were noted as probable slight damage, while in May most of the attacks were recorded as known sunk. It was in May that aircrews were figuring out how to attack the German submersibles. Due to the improved destruction of U-Boats, this intelligence reported that this was the first month that the amount of submersibles sunk were higher than the rate of German submersibles being built.

At the time of this report, the Battle of the Atlantic was in its final stages. The German U-Boats were more cautious in attacking and because of this the amount of merchant vessels lost were very low. Even with this worry by the Germans, Allied aircraft sunk the same amount of submersibles as in May. The difference was that in May the amount of submersible sighted was much higher than in June. These pilots had the skill to properly detect and attack these U-Boats. For my I.S. this report describes the history of aircraft in the Battle of the Atlantic. Specifically, this source states that because the allies were unprepared to fight the U-Boats, a lot of their methods were primitive. It took the allies several months to even realize the potential of aircraft in the Atlantic. Once aircrews were seen as a possible solution to the submersible situation, it took them months for them to be at their full potential. The report states that one of the reasons for their success was the training of crews in specific techniques that could only be discovered through experience.

Although July did not have the same significance in the Battle of the Atlantic as in May, the importance of aircrews is evident in this report. Unlike in June, U-Boat commanders were forced to risk their ships in order to sink enemy vessels. It was in July that this strategy was a two-edged sword. U-Boats sunk more merchant vessels than in June but at a cost. Twenty-seven U-Boats were classified as sunk compared to the six in June. This source also stated how the ratio of merchant vessels sunk compared to U-Boats sunk was .9. In 1942 the average was over nine ships lost for every U-Boat destroyed. This document has a chart to explain the importance of aircraft in the sinking of submersibles. It shows that in January and February of 1943 the amount of U-Boats sunk by aircraft incredibly
low compared to the previous six months. In March it was at its peak, but still aircraft were not destroying as many submersibles as was thought by the high command. The next few months, the percentage stayed high but the amount of sunken U-Boat rose dramatically. The effectiveness of aircraft from May to July is explained because in March and April the percentage of U-Boats sank after an attack were only six percent while in July the number rose to twenty-five percent. It is entirely possible that these numbers are an exaggeration there was still an obvious rise in the efficiency of anti-submarine operations. The report gives some credit to these numbers on the training of aircrews along with proper technologies.


This last intelligence report I intend to look at gives a broad summary on the Battle of the Atlantic. It is obvious by the allies that the battle to protect their cargo is over. The August summary describes the past few months of anti-submarine operations. With the increased loss of U-Boats, less of them were ordered to patrol those waters. The North Atlantic was one of the most dangerous places for convoys in March but in August these waters were one of the safest in the Atlantic. For my I.S. I intend to use that information to demonstrate the effectiveness of aircraft. This report also compares U-Boats sunk, merchant vessels sunk, U-Boats attacked and U-Boats at sea for 1943. This information will allow me to look at the situations in the Atlantic over the past several months.


This is the first of three reports regarding the Army Air Forces in the Second World War. This document explains the role that Army Air Forces had throughout the Atlantic and Pacific theaters. General Arnold first describes the individual pieces that make up his air force. He talks about the women air corps, weather services, etc. Then he goes on to giving information on his aircrews in over Europe and the Japanese islands. This source is useful to my I.S. because it gives details about the training system from 1940 until 1944. The Army Air Force, like many other military groups was low on equipment to properly train their pilots. He compares the session to training someone how to swim by using a glass of water. Only after months of waiting and improvisation did these facilities have the necessary amount of planes and other equipment. This report goes on to say that about a third of the equipment of the Army Air Force was used for training purposes. This shows the importance training had in World War II because the need to prepare new cadets outweighed the need to have combat crews fully supplied.

This newspaper article, written during the U-Boats’ unhindered destruction of American cargo, talks about the problems of the Navy and why they are not able to protect the American coastline. Specifically, this source gives the broad answer that convoy ships and patrol aircraft are not in quantities necessary to become an effective force. The document cannot go in more detail because of the censorship at the time, but even this information is helpful in my I.S. Training facilities were under equipped to give their pilots a realistic experience. This can be attributed to the fact that once a new plane is completed, it is sent to the front where it is badly needed.

Admiral King, Ernest J. on the state of the Navy from peacetime until 1944. Our Navy at War March 27, 1944.

Admiral King writes about the Navy and its operations before March 1944. This official report is a great source to see how the Navy changed and prepared for its involvement in World War II. Included in this source are charts that show increases in personnel and equipment. One part of this document that gives information for my I.S. topic is the section on anti-submarine operations. King explains how he is unable to go into full detail about the tactics used to destroy the U-Boat because the war is still going on. However, he does give a good amount of explanation into the situation right after Pearl Harbor and the growth of Naval air power. The section on anti-submarine warfare starts by stating the general strategies and impact of the submersible war before the U.S. entered. Once America was forced to declare war, King explains how the Navy did not have the necessary forces to protect the entire coastline. He later states the subsequent successes of the U-Boat in the sinking of merchant cargo. The Civil Air Patrol is mentioned as doing a great service for the United States but they cannot handle the power of the German submersible force. He finally states how the in May 1942 anti-submarine forces were being trained and the Army Air Force organized a command for this job specifically. From this information it is easy to argue that one of the reasons why submersibles were victorious on the American coast in the first half of 1942 was because pilots were either not their or they were not trained for the special task for hunting U-Boats.


This autobiography details Charles Lewis’ life as a Naval Aviator during the Second World War. Lewis writes about his young adult life immediately before the Second World War, his training, and his combat missions. This incredible source gives me information about specific maneuvers he conducted in each stage
of his training. This source also shows the emotion and thoughts of a cadet during his training. These descriptions will undoubtedly aide in my fourth chapter on the training programs.


Samuel Morison, a professor at Harvard University, wanted to write about a historical event while it was happening. He thought that too many histories were being written after the fact and many eyewitnesses have moved on. Once Japan attacked the U.S. at Pearl Harbor, Morison went to President Roosevelt and was granted involvement in the war with his specific writing assignment. It should be noted that Morison’s writings follow the Navy’s perspective in the war. He writes about the first half of World War II and how America faced the growing problem of the German U-Boats. Morison describes how the Second World War impacted America’s Navy. In 1939 and 1940 the United States government started to prepare for war. Soon after the Navy started to engage the Axis powers, even though they had not declared war on Germany or Japan. This book then goes on to describe different frontiers that engaged German submersibles in 1942. This information, along with the chapters that talked about the organization and the auxiliary forces in the conflict, is extraordinarily helpful in my independent study. At the beginning of the war the Navy was undersized. The Army Air Force picked up the slack for the Navy and created the Army Anti-submarine Air Command. This group was not the only one that operated in the Atlantic. The Civil Air Patrol consisted of men unfit for combat who flew private planes to search for any submersibles. These facts will help me throughout my I.S. and I plan on using this source in all four of my chapters. This source also gives details on the Battle of the Atlantic that will help me discover new sources for further research.


This book, also written by Samuel Morison, goes into more detail on the Battle of the Atlantic. He talks briefly about the training situation and the creation of air universities in 1943, the attacks on the Bay is Biscay and the German strategies during the battle. This source is important in my I.S. because of the few pages on aircraft training, the summaries of convoys in April and May of 1943 and the operations throughout the Atlantic Ocean. For training, Morison writes about the organization of training stations in 1943 and the creation of the Tenth Fleet. The Tenth Fleet became the Naval unit established for antisubmarine operations. He then describes the protection for convoy ONS-5. This convoy was one of the first examples of the allies taking control of the Battle of the Atlantic. It was in this convoy that 51 U-Boats were deployed and only a handful of merchant vessels were lost.

This source, like the previous two books, gives details on the Battle of the Atlantic from a Naval perspective. This book talks in great detail about the early situation of Antisubmarine units, including the effects of the large sinking of cargo ships in 1943. It is this information that is useful in my I.S. because it allows me to see the impact of the submersible war over time.


The lead scientist of the Anti Submarine Warfare Operations Research Group wrote this article and it was this organization that studied and analyzed the U-Boat war. Philip Morse and his team read through after action reports in the Navy and even sent scientists to work as field agents so they could witness the problems first hand. This document explains the history of operations research in America and it also describes the U-Boat menace in the first couple years of World War II. Specifically, this article states that the Navy was reluctant to hire civilians to help them, until the U-Boat started their destruction of East Coast shipping. The Battle of the Atlantic was getting out of hand and looking at Britain’s use of scientists, America was ready to start studying their failures. Morse also writes how even though they can calculate the proper range and effectiveness of a piece of equipment, his scientists noticed how the crews themselves became another factor to take into consideration. Finally this document talks about the process the scientists went through to obtain their data.


When looking at the seriousness and its overall significance of any conflict, the opinions and worries of the country’s leaders helps the reader see the impact an event had on a nation. This book features the conversations between President Roosevelt and Prime Minister Churchill. This source allows for me to show the scarcity of resources of the Allies at the beginning of the war. Roosevelt comments how the United States can no longer aid Great Britain because the Axis powers were forcing America to move closer and closer to war.


The Tenth Fleet, activated in May 1943, was created to coordinate naval anti-submarine operations in the Atlantic. This document also gives basic details on an anti-submarine measures for the Battle of the Atlantic. Specifically this source gives information on the Air Anti-submarine Development Detachment Atlantic Fleet and the Anti-submarine Attack Teacher Unit Plan. The development
detachment was mainly a research-based organization and was used to find how to effectively use current resources to sink U-Boats. The teaching unit was implemented as a way to properly refresh aircrews on anti-submarine operations. This document is useful in my I.S. since it talks about the naval developments in anti-submarine operations.

Secondary Sources


This document explains the changes made in the Army Air Corps and the Army Air Force in their command structures during the Second World War. In the early years of World War II, the Army Air Corps started to decentralize their organization. Once America entered the Second World War, the Army Air Force effectively reorganized its commands, which includes training. For my I.S., this source describes the complexities of working in an organization that has been decentralized. In some cases flight officers had no knowledge of the training exercises that took place.


This source gives information on the training that Army Air Force pilots experienced during the Second World War. Along with that description, this source also explains the struggles the Army Air Corps and Army Air Force had with the rapid increase of cadets to their training facilities. Specifically, the Army Air Force explains how they cannot properly train their current cadets because of the United States’ need for more operational pilots.


This book describes the U-Boat campaigns during the First World War. William Archer explains the advantages of the submarine and how it surprised the Allies in the first few years of World War I. For my I.S. this source states the impressive capabilities of the U-Boat however it also explains that the submarine needed further development to reach its full potential. The U-Boats thirty years later also needed more advancement to defeat the Allies in the Battle of the Atlantic.

Assistant Chief of Air Staff, Intelligence Historical Division, *The Antisubmarine Command*. Army Air Force Historical Studies 107, April 1945.

This document describes the history and operation of the Antisubmarine Command of the Army Air Force. The Antisubmarine Command held the responsibility of patrolling the Atlantic Ocean against the German U-Boats. Learning the specifics of the command helped me in explaining the usefulness of
this organization during the Second World War. The creation of this command improved the previous unit in charge of anti-submarine operations. Specifically, this source details the training that pilots went through and also the pilots that comprised of the Antisubmarine Command. This document allows me to explain the effectiveness of an organization devoted to hunting the U-Boats. Since the pilots in this Command came from the unit that previously patrolled the Atlantic, the staff knew many specifics of this kind of warfare. Also pilots in this organization had more precise training in anti-submarine operations.

Assistant Chief of Air Staff, Intelligence Historical Division, *Initial Selection of Candidates for Pilot, Bombardier, and Navigator Training*. Army Air Force Historical Studies 2, November 1943.

This study looked at the Army Air Force’s methods of selecting Americans to enlist as cadets. This document details the test given to potential cadets and the statistics of how many pilots the Army Air Force selects in a given year. This source helps my final I.S. chapter because it states that the Army Air Force changed their test for potential pilots during the Second World War. Instead of earlier written test, which consisted of a variety of questions, the new examination system asked the student questions that dealt with flying situations. Thus, the accepted cadets had a better working knowledge of flying situations before they even took off in a plane.


This book describes the contributions that scientists made during the Second World War. The majority of this book summarizes the technologies that scientists created during the war. From radar to flamethrowers to anti malaria drugs, scientists brought research and analysis into motion. Besides this additive for the Allies, these scientists also researched the proper ways to use new and existing technologies. For my I.S. I will use the parts on the improvement in techniques that needed to be mastered by the military personnel operating them.


This article gives information on the elimination bases at the beginning of the Second World War. Specifically, the author gives his account of the training he went through before he became an aviation cadet. I intend to use this account as a way to describe how Naval Reservists worked to change their status in the Navy to be Naval Aviators.
This book contains information of Naval Aviation in 1943. This source replaced the book Naval Aviation 1934 and details the organization, history and training of personnel in 1943. For my Independent Study the organizational facts and training stages paints a clear picture on Naval Aviation during the Second World War. This book goes step by step of Naval training, including what the cadets learned and for how long they practiced these procedures before moving on to the next class. All of these facts will help my second chapter, which deals with the organization of the Navy and the training curriculum during World War II.

This book describes the history of Naval Aviation including its development, organization and training program. From the origins of Naval Aviation until the War in Korea, this book talks about the changes of this growing field and the challenges of the Navy in different moments in time. For my I.S. the chapters on the training program contain information valuable for my second chapter. Specifically, the establishment of a civilian training program shows the United States’ commitment to improving their pilots before they go off to war.

This book describes the Navy’s role in World War II. Specifically, Cant writes mostly about Naval operations in the Pacific Theater, but he does dedicate some time to the Atlantic campaigns. Cant’s detailed work on the Atlantic Front will be quite helpful in my research. He first explains the early U-Boat operations in the Atlantic but then goes on to state how anti-submarine warfare was treated as a secondary mission only when Naval forces were not needed in the primary operations. He also talks about the situation on the Atlantic Coast. This shows the United States’ failures early in World War II. Finally this book gives information on the establishment and friction of the Army and Naval aviation branches.

This book compiles several different aspects of flying in the Second World War and details different situations of the pilots. The source examines the war over Europe, Japan and even the Atlantic. Specifically this book describes the training regiment of pilots in the U.S. Navy and Army Air Force. I intend on utilizing this book when I have to explain the specific programs that pilots went through before they became operational aviators.

This book examines the changes in aviation training by the Navy during the Second World War. The source describes the administrative changes of the training programs. For My I.S. I intend to use the first chapter, on the administrative organization of the Naval Air training program. This chapter focuses on the efforts for the Navy to centralize its commands pertaining to training. Specifically the statement from the Committee on Naval Affairs of the House of Representatives demonstrates how the current administrative organization of the Naval districts has hindered the training of pilots in the U.S. Navy.


This book gives biographical information on Hap Arnold, the commanding General of the Army Air Forces, and information on the development of American air power. As the General of the Army Air Forces he was in charge of their new responsibility to fight U-Boats on America’s coastline. This source gives information on Arnold’s decision to create an operational analysis unit to research the most effective ways on attacking submersibles. This book is useful in my project because it gives reasons why operational analysis was both a practical and powerful method of improving one’s forces.


This book looks at U-Boat 123 on its voyages to the American coast in 1942. This source shows the German experience in the attack on merchant vessels. I intend to use this source to see the changes in anti-submarine operations from their first voyage in early 1942 and their last mission in the middle of 1942. I can also read about the reaction of the German sailors while they were operating in the Western portion of the Atlantic. For my I.S. I will use this book specifically because it describes the end of Operation Drumbeat. The U-Boat forces were ordered to operate in safer waters towards the end of 1942. Gannon writes about the use of operational analysis and how during these later months trained men were beginning to work towards sinking the German submersibles.


This book not only studies the navies that fought in the Battle of the Atlantic but in the entire Ocean war from 1939 – 1945. This source describes the reactions and strategies of the higher commands and the ordinary seaman during this long conflict. For my I.S, this book gives valuable information on the background of
the Battle of the Atlantic. This includes the naval situation of each power at the onset of war and the tactics of each side.


This book gives the history of the Atlantic operations during the Second World War. From America’s first missions in the Atlantic Ocean in 1940 to the capture of Cherbourg in 1944, this source describes the changing situation. For my Independent Study, the chapter of the anti-submarine war gives me useful information on the movement of the American Navy from a powerless force in the Atlantic to an effective submersible organization. Specifically the authors wrote about the Tenth Fleet and how the Navy organized this new fleet dedicated to anti-submarine operations.


This source details the beginnings of the airplane in a combat setting. Along with a description of the technology, this book explains how the men trained to use the airplanes and how they fought in Europe. For my I.S., explaining the roots of air combat and technology will help in arguing that the Allies needed to focus on training because the airplane entered the twentieth century as untested technology.


This source details U-Boat operations throughout the Atlantic Ocean. It then puts the entire war into perspective to give the reader a detailed history of World War II and what the submersibles were up against. This book gives a lot of information on the successes of the U-Boat offensive known as Operation Drumbeat in 1942. Mason’s descriptions allow me to write about the American failure to prepare for an anti-submarine conflict. An extensive narrative is necessary to give the reader an overview into the Battle of the Atlantic so they can better understand the complexities of this theater of war. All of that information will make it far easier to explain the tactics and techniques pilots needed to learn in order to sink a U-Boat.


This article gives information on the growth of operations research in both the Atlantic campaign for Great Britain. Following the development and the impact of the anti-submarine operations group I see the importance of civilian scientists for the U.S. and British Navy. This source states the many bases these scientists went to and the relationship between American scientists and those in England. Finally

This secondary source gives a general history on the Battle of the Atlantic. For my Independent Study, I intend to use book to describe different parts of the U-Boat war. From the beginning of the war in Europe, off the coast of England, to America’s entrance, off the United States’ Eastern coast, the impact of the German U-Boat was immense. This information will allow me to explain the effects of the Battle of the Atlantic.


This book gives a detailed history of the Army Air Force from 1939 until August 1942. This source gives information on the inception of the American Air Corps, its changes in organization, preparation for war and finally its early operations against the Axis powers. One chapter in this book that I will give a lot of attention to is the Battle of the Atlantic. The authors write about the differences of jurisdiction and training between the Army and Navy Air Forces. They also go on to state the Army Air Force’s changes when asked to protect American shipping and also it’s impact on the U-Boat war. This book is a great source for my research because of the chronological detail of the Army Air Force, and its anti-submarine operations. Specifically, it describes the Army Air Force’s readiness to fight submersibles. They were not trained at all in dealing with U-Boats yet they were expected to fight them. At the beginning of the war the Navy’s lack of resources forced the Army Air Force units to fight on their behalf. Also, the units equipped to destroy U-Boats were trained in the Army Air Force’s primary function of bombing area and little practice was given to anti-submarine patrol. Next, not only were trained Naval aviators sent to the Pacific but also trained Army aviators were sent to the West coast of the United States. While the AAF pilots knew how to bomb specific areas, the bombing techniques for anti-submarine operations were very different than bombing land based targets, thus the U-Boats had little to worry about.


This book, like the first volume, gives a detailed history of the Army Air Forces in World War II. This volume in particular gives information from August 1942 until the end of 1943. This source describes the Army Air Force’s operations in Europe, specifically, in Italy, Africa and in the Atlantic. For my I.S. the chapter on anti-submarine warfare is ideal for my research. The authors write about the improvements of the Army Air Force units later in the war against the U-Boats.

This book looks at the Battle of the Somme in the First World War and a brief history in the years before and after. Specifically, the author explains the history of the tank and its first use during the Great War. This information helps describe the growth of technology in the twentieth century and how the tank, like all new technology between 1914 and 1918 required improvement.


This book looks at the history of the aircrafts used in Bermuda. Specifically this book details different operational missions in Bermuda. For my I.S. I plan on using the extensive information on each individual flying boat the Naval Aviators flew during the Second World War. This information includes the crew size, distance, and armament of each plane, which will give the reader and myself basic knowledge of the planes I plan on writing about.


This book gives a general history on the Second World War. This compelling novel describes complex aspects of each campaign in a fluid and simple way without losing any necessary data. The chapter on the Battle of the Atlantic gives plenty of information perfect for my introduction or any introductory paragraph in my I.S. Also this source gives many quotes from famous characters in the war that demonstrate different themes of this violent war.


This secondary source gives a general history on not only the Battle of the Atlantic but on any sea engagement during the Second World War. For my I.S. the information Roskill gives on the invasion of German U-Boats on the American coastline helps paint a picture about the bleak situation for Allied military personnel and civilians in the first few months on 1942. Specifically the data printed in the appendices at the end of the book explains the changes in strength of both forces throughout the war. It is the information that I plan to use directly in my first chapter.


This source talks about the history of anti-submarine operations by the Navy from the Second World War until the Korean War. This source writes about the planes and operations of aviators in anti-submarine operations. For my I.S. this source gives a lot of background information on sea-based missions and development,
however, I intend on only using their description of the organization of anti-submarine operations. This source details the Navy’s push for complete control in the Atlantic Ocean with their creation of the Tenth Fleet in 1943. Specifically, the Navy writes about the problems they have had in dealing with joint control with the Army Air Force.


This article describes how the Navy trained their instructors in primary flight training. This source helps me detail who the Navy chose as teachers during the Second World War in Naval Aviation. These men helped the cadets learn how to properly fly their aircraft.


This book describes the operational evaluation of anti-submarine warfare during the Second World War. The authors dedicate the first half of this source to summarize different periods of the Battle of the Atlantic. From 1939 until 1945 the book explains U-Boat offensives throughout the war and the subsequent countermeasures. Under the category of countermeasures the implementation of both aircraft and scientific research are brought up. The second part of this book sheds light on specific scientific evaluations during the course of the war. The descriptions of attack errors and offensive searches have given a large amount of information that has been useful in my I.S.


This book explains the implementation of scientific research during World War II. This source mainly describes the history and organization of the National Defense Research Committee. The sub divisions of the NDRC are also mentioned in this book. I will use the information on the organization of the Antisubmarine Warfare Operations Research Group, a sub division of the NDRC in my third chapter. Along with that description, the book talks about the use of field agents who determined problems to analyze, which is essential in my I.S for examining the relationship between the training commands and the scientists.


This book on the Battle of the Atlantic gives most of the credit towards technology and implementation for why the allies were able to protect their convoys. In Syrett’s eyes, the victory of the Battle of the Atlantic depended on the safety of the merchant vessels. He brings up a good point because the German
objective was to destroy enough cargo to choke the economy of Britain. For my I.S. I will be looking at the destruction, not the defeat of the U-Boats. This book does give a narrative on several convoys from April until September 1943, which can be helpful if I wanted to describe the situation of American naval personnel in the Atlantic. Syrett also gives information on the technologies of the Allied aircraft and the changing situation in the Atlantic. Those details will help me in understanding the proper chronology of the battle.


This book details the Navy’s air campaigns in World War II. The Aviation History Unit describes the Atlantic and Pacific Theaters of Operations and then the civilian forces that helped the war effort. Specifically the author explains the improvement of Naval aviation and its readiness at the start of the war. The next few chapters detail the operations conducted by Naval pilots. The final section of this source talks about the training of Naval aviators. The techniques describes here will be incredibly useful in my final chapter of my I.S.


This book gives information on scientific methods to improve naval officers in their decision-making skills. The first few chapters of this source describe the history and organization of operations research. With this information, I will write about the creation and general procedures of operations analysis by the Navy. Further in this source, the explanation of search and patrol research gives my I.S. a more detailed look at operations research in the Battle of the Atlantic.


This book focuses on the history and campaigns on the German Navy in the Second World War. This source allows the reader to view the development of this highly technical Navy. From the end of World War I the German High Command needed to organize their Navy and determine its future. This book moves on to the onset of World War and the subsequent areas of operations by the newly improved U-Boat. From this information I can write on the German reasoning and strategies in each area during the Battle of the Atlantic.


This source describes the history of Operational research and specific instances where this research found solutions to problems in the Second World War. The general view of Operational Research is that it allowed for the analysis on how to
use instruments of war instead of solely its creation. For my I.S I intend on talking about British analysis and specific operations where Operational research helped in anti-submarine warfare.


This government document looks at the use of aircraft in the Battle of the Atlantic. This source is useful because it gives a summary of the war against the U-Boats for the Army Air Force. Specifically, this document states that the low amount of cargo ships sunk in November and December were caused by a redirect of submersibles from the North Atlantic to the Mid-Atlantic


This book describes the history of the Naval Air Station at Jacksonville, Florida. Included in this history is the operations conducted on the base. This source writes about the Navy’s commission of the Naval Air Station, the social lives of the cadets, the operational history on the base, and a general history of the base year by year form 1940 until the present day. For my I.S. the operational history gives an immense amount of information pertaining to training and how the base prepared for war. Specifically this book details the training of the cadets and the development of different training programs during the war years.