USAWC STRATEGY RESEARCH PROJECT

U.S. NAVAL MINE WARFARE STRATEGY: ANALYSIS OF THE WAY AHEAD

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ABSTRACT

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The history of naval mine warfare in wars and conflicts has taught the United States Navy many valuable lessons. Unfortunately, many of these lessons learned have, for the most part, been painfully relearned in successive wars and conflicts. Compared to more glamorous naval mission areas such as strike warfare, mine warfare has usually been under funded and had difficulty maintaining momentum toward improving fleet capabilities in this vital mission area. Sea mines today remain a serious threat to U.S. strategic interests in key regions of the world. The United States Navy today is embarked on an ambitious plan to improve and transform its mine countermeasures capabilities. This paper discusses common themes and lessons learned in past wars and conflicts, depicts the current mine threat, discusses current force structure, analyzes the Chief of Naval Operations Sea Power 21 vision for improving long term mine warfare capabilities and provides recommendations for improving near term readiness.

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U.S. NAVAL MINE WARFARE STRATEGY: ANALYSIS OF THE WAY AHEAD

> Regarding mine warfare, I believe that the analysis will present us with one of the transformational alternatives for the future, and it is about speed. We need a ship that is able to respond anywhere in the world at high speed. A key part of what this ship has to be able to do is be able to do mine warfare in the littorals. That is where we are going. We believe that is the best course of action. We believe it takes our navy into the future, and that is our commitment.
>
> — Admiral Vern E. Clark, Chief of Naval Operations
> Before the House Armed Services
> Committee on 13 February 2002

Naval mine warfare has played a prominent role in United States wars and conflicts as far back as the Civil War. Mine warfare sailors embroiled in these operations rose to the challenge time and time again, with heroic efforts under the most difficult circumstances. Unfortunately, for the most part interconflict years were marked with a cycle of neglect, including excessive budget decreases, lowered readiness, drop-off in capabilities, and a general leadership malaise towards mine warfare. More glamorous warfighting areas such as submarine, air and surface warfare favorably compete for the best and brightest talent and preponderance of resources. Many of the same painful lessons learned have been relearned in successive conflicts.

Sea mines today remain a serious threat to U.S. strategic interests in key regions of the world. Robust U.S. naval mine countermeasures (MCM) capabilities are important to guaranteeing assured access in these regions of critical strategic interest. Today's senior Department of Defense (DOD) and Naval leaders are keenly aware of the need to improve and maintain this capability They are embarking on a visionary path to counter the cycle of neglect, by transforming the MCM force while maintaining credible current capabilities. Success requires commitment by senior leaders to continue addressing near term requirements as force transformation matures. Leaders must stay the course and avoid letting mine warfare once again slip to a "less significant" mission area.

EARLY YEARS OF MINE WARFARE

The origins of naval mine warfare can be traced to the Revolutionary War. The fledgling United States did not have a navy remotely capable of matching the strength of the British fleet, so it created watercraft and weapons to attack the British ships using unexpected methods.[1] David Bushnell, a naval inventor, built the worlds first submarine (*Turtle*) in 1776, which unsuccessfully attempted to attach a small limpet mine to a British ship.[2]

Undeterred by this failure, his efforts expanded to devising other means of attacking British ships. In 1778, he developed what most likely were the first naval mines, watertight kegs filled with black powder designed to detonate via a rudimentary flintlock device upon contact with a ships hull.[3] Tactical employment of these weapons however, proved very challenging. In 1778 Bushnell attempted to target British ships anchored off Philadelphia in the Delaware River.[4] However, currents and ice flows pushed the mines off course where they exploded along the river's banks.[5] While Bushnell's inventions achieved little success during the Revolutionary War, they nevertheless planted the seed for future development of the perfect asymmetrical weapon.

THE CIVIL WAR

The Civil War proved that strategic mining operations could effectively alter the balance of naval power between adversaries. The Confederacy, lacking a strong navy, aggressively funded mine warfare and innovatively employed mines throughout the course of the war. At the war's onset, the Union Navy was not prepared to counter the Confederate mining threat. This lack of preparation was mostly due to the low regard held by Union Naval officers towards those resorting to this unsophisticated type of warfare. Admiral David Farragut, writing to the Secretary of the Navy Gideon Welles at the beginning of the war stated: "I have always deemed it unworthy of a chivalrous nation, but it does not do to give your enemy such a decided superiority over you."[6] Welles showed little interest in funding Union Navy mine warfare research leaving it up to individual ship captains to develop their own countermeasures and protection devices.[7] This approach proved very costly to the Union Navy. Of the fifty ships crippled or sunk during the Civil War, four-fifths of them were Union vessels.[8]

The psychological aspects of mine warfare also proved to be as important as the actual sinking of ships. Many times the mere suspicion that mines were present disrupted or forced the cancellation of Union operations.[9]

During the course of the War, individual Union fleet captains such as Rear Admiral David Porter, eventually devised innovative devices such as "torpedo catchers" and developed tactics to help counter the threat. But success was largely due to individual officers rather than a coherent operational or tactical institutional approach to mine warfare. At the war's end, mine warfare remained dependent on the interest of individual officers, just as it had at the beginning of the war.[10]

For the remainder of the nineteenth century, the U.S. Navy made little progress in mine warfare strategy or procedures. Admiral Porter chided the Navy and Congress in 1886 for

failing to fund mine warfare, but constrained peacetime resources ensured minimal progress.[11] Even the sinking of the battleship Maine by a mine in Havana harbor in 1898 failed to provide the impetus for new mine countermeasure (MCM) forces or a cogent strategy for countermining.[12]

The 1904 Russo-Japanese War included new strategy and tactics. During the Port Arthur campaign, instead of employing mines as a defensive tactic in only shallow waters, both the Japanese and Russians employed independently moored contact mines planted in the open sea where small minesweeping boats could not navigate.[13] Lessons learned for the Russo-Japanese War inspired several navies, led by the British and French, to revamp their mine warfare programs with new interest in active mine countermeasures. Despite recognizing the need for centralized control of mine warfare issues and programs, the U.S. Navy could not overcome institutional intransigence over competition for resources and failed to match the efforts of other navies.

WORLD WAR I

The United States entered World War I with ten tugs assigned permanent minesweeping missions, only four of which were ready for duty.[14] Once again, there was not a coherent strategy to keep mine warfare capabilities on par with the rest of the Navy. It remained the burden of individual officers to keep any semblance of interest in mine warfare alive. Each fleet torpedo flotilla commander controlled MCM operations as a collateral duty, and due to a lack of their expertise, copied minesweeping procedures directly from British minesweeping manuals.[15]

During World War I, Germany mined the British and United States coasts, the British mined the English Channel and the Turks mined the Dardanelle Straits. Near the end of the War in 1918, the United States and Britain combined during the North Sea Mine Barrage to lay 73,000 mines set across 134 miles.[16] All navies involved in the War suffered damage by mines. The British suffered devastating losses in the Dardanelle's when four capital battleships were lost or damaged while attempting to run a minefield.[17] At least six American ships were sunk by mines off the United States east coast.[18]

German mining successes spurred the U. S. Navy into action. By the end of the war it had built a fairly capable MCM force consisting of 54 "Bird" class minesweepers equipped with the latest technology. Tactics and procedures improved, out of necessity due to the extent of the enemy mining problem. In order to clear the mines laid during the North Sea Barrage, the United States used 82 ships and 4,000 men working 18 hour days over a five month period.[19]

At wars end the investment in capabilities and surge of interest in mine warfare proved to be short lived. Perhaps since U.S. Naval losses were not as severe as those suffered by other navies, justifying the expense of maintaining a capable peacetime MCM force proved too difficult a task. Within weeks reserve units disbanded and minesweepers were laid up, once again leaving the future of mine warfare in the hands of those active duty officers interested in keeping the spirit of mine warfare alive.[20] Senior naval leaders remained uncommitted towards advancing mine warfare as a sought after professional field, and career officers saw little glory or promotion potential in this tedious line of work; consequently interest in mine warfare quickly waned after World War I.[21]

THE INTERWAR PERIOD

Mine warfare received little serious attention in the United States during the 1919-1938 interwar period. While the Navy established a mine unit research capability at the Washington Navy Yard in 1919, which later merged with the Naval Ordnance Laboratory in 1929, research and practical application suffered from a lack of knowledgeable personnel and meager budgets. The vast majority of mine warfare vessels remained in lay-up status and fleet exercises routinely reverted to simulating the mine warfare problem.

Overseas however, interest in mine warfare remained strong, particularly in the British, German and Russian navies. All developed influence mines and experimented with new methods of delivery, including air dropping bottom influence mines.[22] As World War II approached, the U.S. Navy, once again lacking the commitment, resources and expertise fell behind allies and adversaries in mine warfare research and capabilities.

WORLD WAR II

The onset of war in Europe, specifically German mining of the British coast in 1939, once again rekindled the U.S. Navy's interest in mine warfare. Germany utilized old World War I contact mines but also introduced newer, sophisticated influence mines which were extremely difficult to counter.

With mine warfare administration haphazardly spread over various Bureaus and Naval Districts, the Chief of Naval Operations, Admiral Harold R. Stark, turned to Captain Alexander Sharp, a former minelayer commander, to bring order and direction to mine warfare efforts.[23] Sharp faced a daunting task. The fleet lacked mine warfare expertise and capabilities had eroded to dangerously low levels. Nevertheless, from 1939-1941 Sharp succeeded in establishing a Mine Warfare School, rejuvenated research and development and spearheaded

shipbuilding priorities for new minesweeping vessels. Despite these efforts, mine warfare integration with other Navy warfare mission areas remained unsatisfactory.

The attack on Pearl Harbor in 1941 and subsequent German U-boat influence field mining and closure of Delaware Bay, Chesapeake Bay as well as Jacksonville, Florida, and Charleston, South Carolina in early 1942, significantly spurred even greater interest in restoring the U.S. Navy's mine warfare capabilities.[24]

Congressional budget increases resulted in immediate increases in mine countermeasures vessel shipbuilding programs.[25] The sharp rise in new mine sweeping ship inventories posed organizational command and control issues in both the U.S. Atlantic and Pacific Fleets. While Atlantic Fleet active and reserve minesweepers came under the administrative control of Vice Admiral Sharp in August 1942, it was not until October 1944 that a similar specialized command structure existed in the Pacific Fleet.[26] Ironically, spurred by Pacific Fleet Admiral Ernest King, it was Vice Admiral Sharp who voluntarily gave up his third star, reverting to Rear Admiral to administratively and operationally command the first MCM type command (Minecraft Pacific Fleet).[27]

The U.S. faced operational and tactical mine warfare challenges and significant risks in both the European and Pacific theaters. The greatest European theater mine warfare challenges occurred during the Normandy invasions in 1944. In early 1944, Hitler ordered that 4000 pressure mines be sown around Normandy, Le Havre and Cherbourg.[28] Extensive combined British and American minesweeping operations preceded the Normandy landings. While several combatant ships and landing craft were subsequently lost to mines during the invasion, losses could have been far more substantial. Post-clearance operations uncovered large numbers of influence bottom mines that the invasion forces inadvertently and miraculously managed to avoid.[29] The port of Cherbourg was so heavily mined it took Allied forces eighty-five days sweeping eight times per day to ensure the passage of friendly ships.[30] In the Pacific the largest minesweeping operation occurred prior to the 1945 landings at Okinawa, where 3000 square miles were swept prior to landing day with over 250 mines swept and destroyed.[31]

As they did in World War I, mines played a significant role in World War II. Between 1939 and 1945 mines sank more than 1100 Allied ships, with the United States alone losing 108 ships with 85 others damaged.[32] As devastating as these losses were, the U.S. quickly let mine warfare capabilities deteriorate during the post war period. Mine warfare lost out once again in the competition for peacetime resources to the more traditional air, surface and subsurface warfighting assets. The many reservists that made up the core of the minesweeping fleet

returned to civilian life, and once again mine warfare was left in the hands of a few interested individuals remaining on active duty.[33] Mine warfare remained an unglamorous profession lacking strong, consistent senior Naval leader support.

KOREA

The U.S. Navy was ill prepared for the size and scope of the mine warfare problem faced during the Korean War. Post WWII force draw down and lay-up of minesweeping vessels left only 12 active minesweepers and 6 small minesweeping boats (MSB's) available for duty in the entire Pacific Fleet.[34] More importantly, remaining force readiness had dropped precipitously to low levels. The Soviet Union conversely maintained an impressive mine warfare capability, providing the North Koreans with both moored contact and magnetic influence mines.

General Douglas MacArthur's bold decision to conduct an amphibious landing at Inchon to cut off North Korean forces besieging Pusan involved an element of luck. The North Koreans miscalculated the range of tide in the assault channel, enabling U.S. destroyers to site and destroy most of the mines prior to the invasion.[35] Three hundred Russian influence mines delivered to the North Koreans lacked harnesses and were not deployed in time for the invasion.[36] The Inchon landings could have been much more difficult if these mines were in place prior to the invasion.

The Navy's luck however ran out and it suffered an embarrassing setback in 1950 during General MacArthur's planned combined land and amphibious attack on Wonsan. Landings were delayed for one week while a marginally equipped and unprepared minesweeping force attempted to clear massive minefields. Rear Admiral Allan Smith, the commander of the amphibious task force, summed up the Navy's humiliation as follows:

> The Navy able to sink an enemy fleet, to defeat aircraft and submarines, to do precision bombing, rocket attack, and gunnery, to support troops ashore and blockade, met a massive 3,000 mine field laid off Wonsan by the Soviet naval experts … The strongest Navy in the world had to remain in the Sea of Japan while a few minesweepers struggled to clear Wonsan.[37]

The Navy's top leaders also took notice, summarized by then Chief of Naval Operations Admiral Forrest Sherman's candid remarks:

> When you can't go where you want to, when you want to, you haven't got command of the sea. And command of the sea is a rock-bottom foundation of all of our war plans. We've been plenty submarine-conscious and air conscious. Now we're going to start getting mine-conscious --- beginning last week.[38]

From 1950 to 1953 mines accounted for nearly 70 percent of U.S. and allied ship losses and casualties, and minesweeping personnel while making up only 2 percent of U.S. naval forces in Korea suffered more than 20 percent of the Navy's losses.[39]

The troublesome Korean War experiences prompted the Navy into revamping its deficient mine warfare organization and revitalizing research efforts. The Navy added 65 new ocean going minesweepers and 22 coastal minesweepers and increased its research and development effort at the MCM laboratory at Panama City, Florida. For the first time the Navy started testing helicopters in towing devices for airborne mine countermeasures (AMCM). Despite these increases, mine warfare remained an unglamorous, tedious profession once again eventually falling behind in the post-war competition for scarce resources. By 1958 any new funding for MCM construction was regularly deleted for the Navy budget.[40] Navy leadership once again sent mixed signals on their commitment to maintaining a capable mine warfare force.

VIETNAM ERA

Mine warfare operations in Vietnam were unlike those the Navy had become accustomed to conducting. No longer could it focus mainly on coastal or minesweeping operations preparing for amphibious assaults. The bulk of North Vietnam's mining threat took place in the rivers of South Vietnam where relatively unsophisticated mines were used by the Viet Cong to attack shipping.[41] The Navy had to tackle this problem with small minesweeping boats (MSB's) and develop inland waterway warfare expertise. The larger oceangoing minesweepers (MSO's) developed as a result of the Korean War Wonsan failures, were unsuitable for this mission and played a secondary coastal operations role for most of the war.

The extended long term riverine operations and continued deployment of MSO's took a heavy toll on the force. Logistics and operational requirements drained funds from refurbishment programs, resulting in many MCM ship decommissionings by 1970. Admiral Elmo R. Zumwalt, Jr., immediately after becoming Chief of Naval Operations in 1970, took an immediate interest in trying to revitalize mine warfare. His main interest focused on improving the speed at which MCM operations were conducted, placing emphasis on airborne mine countermeasures over surface countermeasures.[42] Equally important, he centralized control of all air, sea and undersea MCM assets under a two-star admiral, Commander Mine Warfare Force (COMINEWARFOR) at Charleston, South Carolina.

The integrated emphasis on air and surface MCM operations, coupled with solid unity of command proved valuable for major mine clearance operations conducted during Operation

End Sweep in 1973. In 1972 the U.S. mined the river approaches to Haiphong Harbor, disrupting North Vietnam's resupply efforts and contributing to Hanoi's cease-fire negotiations. During Operation End Sweep, the U.S. Navy neutralized the mines laid in North Vietnam's waters, successively employing airmobile countermeasures for the first time in a major operation.[43] Operation End Sweep proved the value of aircraft deploying quickly overseas, operating in relative safety from exploding ordnance and detecting shallow water magnetic and acoustic mines.[44] While Operation End Sweep proved that MCM operations were a valuable component of naval warfare, Admiral Isaac C. Kidd, Chief of Naval Material, summed up his frustration with the Navy's uneven approach to mine warfare: "minesweeping seems to acquire sex appeal once every 25 years. The intervening hiatus is quite a hurdle to overcome."[45]

There were further declines in the numbers and readiness of mine warfare ships during the latter half of the 1970's. As budgets decreased COMINEWARFOR's authority and responsibilities also decreased, as the remaining MCM units were placed under the Commanders of both the Naval Surface Force Atlantic and Pacific Fleets.[46] It was not until the Reagan Administrations defense build-up years of the 1980's that mine warfare saw somewhat of a resurgence. The *Avenge*r class of minesweepers, the first new minesweepers built since the Korean War, were authorized in 1981 with the first of 14 of the class commissioned in 1987. Still, despite some new capabilities, MCM forces did not garner much attention or budget share, and integration with other U.S. forces remained behind other European North Atlantic Treaty Organization (NATO) members.[47]

THE GULF WARS

The 1980's Iran-Iraq War and the 1991 Gulf War both involved significant mining incidents of strategic importance. For the United States, these operations again provided ample evidence that maintaining a rapidly deployable, capable and professional mine warfare force is essential to maintaining open and secure sea lines of communication.

In 1986, using swarms of small boats, Iran seeded the northern areas of the Arabian Gulf and the entrance to the Straits of Hormuz with turn of the century primitive Soviet Union M-08 contact mines.[48] Believing that the U.S. reflagging and escort of Kuwaiti vessels (Operation Ernest Will) favored Iraq, Iran mined the Gulf waters intending to disrupt the flow of shipping. Their mining operations achieved success when the *Bridgeton*, a reflagged Kuwaiti supertanker, struck a mine while under escort. The U.S. subsequently airlifted eight minesweeping helicopters and six oceangoing minesweepers to the Gulf.

In 1988 the Iranians again seeded the shipping lanes with mines. Following an escort mission, the USS *Samuel B. Roberts* (FFG 58) struck a mine and nearly sunk. During the Persian Gulf War in 1990-1991, Iraq planted approximately 1150 mines in fairly sophisticated minefields off the Kuwaiti coast, directly affecting naval operations during most of the campaign.[49] The Iraqi's used a dual mining strategy, protecting their seaward flank from an amphibious assault and deliberately seeding some mines adrift to disrupt naval freedom of maneuver.[50] This strategy worked well, confounding coalition planning for an amphibious assault and severely damaging two U.S. naval ships. On February 18, 1991 both the USS *Tripoli* (LPH 10) and USS *Princeton* (CG 59) suffered mine damage. *Tripoli* blew a large 20 by 16 - foot hole in her hull, while the *Princeton* detonated a 375 pound Italian made Manta magnetic, acoustic influence mine forcing her to spend the remainder of the war being repaired.[51]

The Gulf Wars once again taught the United States another painful lesson. As shown in Figure 1, with minimal investment nations possessing naval mines can inflict severe damage to a numerically and technologically superior enemy.

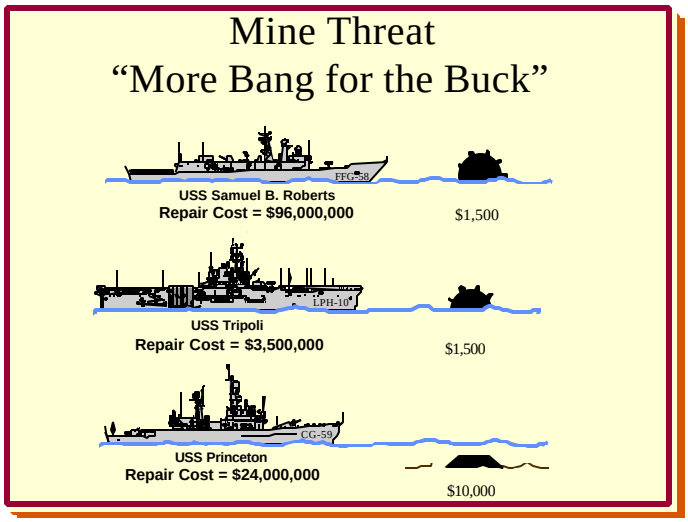

FIGURE 1 – THE PERFECT ASYMMETRIC WEAPON[52]

Once again, senior navy leaders vowed to correct the deficiencies. In November, 1991, then Secretary of the Navy, H. Lawrence Garret stated:

> The Persian Gulf War has taught us more than a couple of lessons recently about our neglect. As we operate more and more in confined coastal waters, and as scenarios requiring over-the-horizon amphibious assaults become more probable, we will be confronted increasingly with cheap and widely available mines. I, for one, have no intention of seeing the Navy someday forced to tell the President that we can't do the job because we're unable to defeat the enemy's mines.[53]

As a result of these problems, the Navy spent the remainder of the decade tackling near-term readiness issues. It also invested heavily in organic MCM systems, intended to give forward deployed operating forces the ability to conduct some MCM operations on their own without relying on dedicated MCM forces. Secretary of Defense Cohen, and a strong Congressional Mine Warfare Caucus, were instrumental in not allowing current MCM capability to atrophy at the expense of investment in future MCM organic systems.

The Fourth Edition of the U.S. Naval Mine Warfare Plan, published in 2000, outlines the way ahead for mine warfare. With strong backing from then Chief of Naval Operations Admiral Jay Johnson and Commandant of the Marine Corps General James Jones, it provides a detailed roadmap for improving near-term capabilities, fielding mid-term organic mine warfare systems and focusing on longer term capabilities. The strategy is sound, but history has shown U.S. interest in mine warfare tends to wane between conflicts. The Navy is now at a critical juncture in trying to keep the 1990's momentum alive. It faces the challenge of transforming the force while avoiding return to the cycle of neglect repeatedly demonstrated in past interconflict years.

CURRENT THREAT

Naval mines today remain the perfect asymmetrical weapons, capable of disrupting assured access in areas of strategic importance to the United States and their Allies. Every type of naval mine is available in the global marketplace.[54] The 1996 Paris International Naval Exposition offered many mines for sale, from simple contact mines to sophisticated bottom influence mines.[55] More than 50 countries today have a sea mining capability and mines are becoming much more difficult to detect and counter. Sweden, Russia, China and Italy continue to manufacture and export sophisticated mines built with stealth technology, irregular shapes, anechoic coatings and nonmagnetic materials.[56] Advanced microprocessor-controlled target detection devices, ship counters, remote control features and delayed arming mechanisms make detection efforts very difficult.[57]

Wide proliferation coupled with numerous strategically vulnerable areas present significant challenges. Many U.S. Navy and Marine Corps contingency regions have sizeable mineable waters, including the Persian Gulf, the Strait of Hormuz, the Taiwan Strait, the Red Sea, the Adriatic Sea, the Yellow Sea, the Korea Strait and coastal margins of the Sea of Japan.[58] Figure 2 depicts the challenging undersea battlespace facing MCM planners in these vital strategic areas.

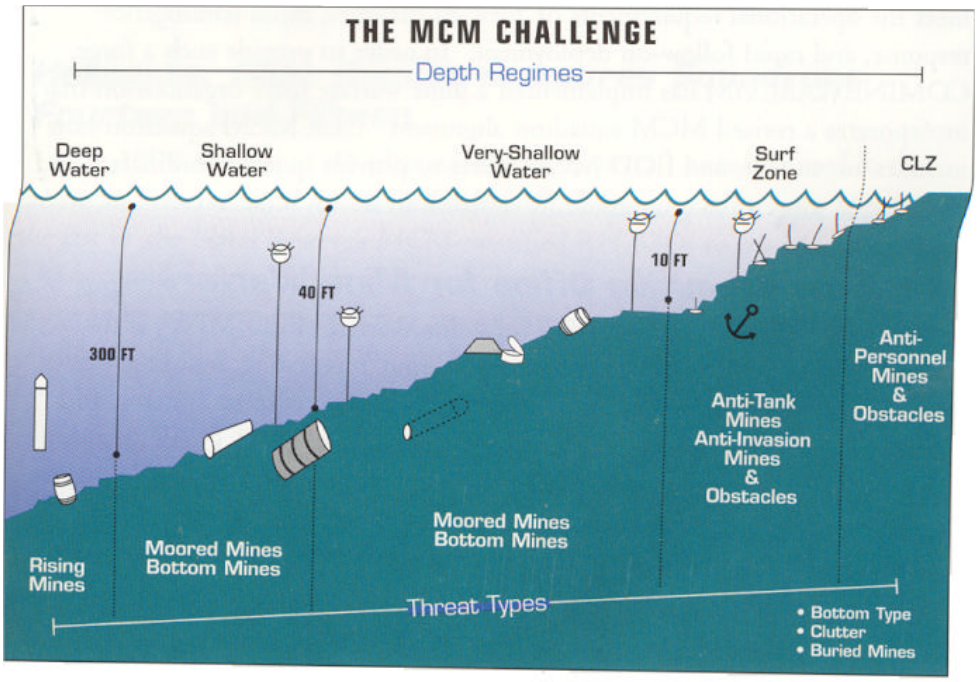

FIGURE 2 – THE DEMANDING MCM OPERATIONAL ENVIRONMENT[59]

Terrorists no doubt have also studied the benefits of using naval mines as asymmetric weapons. The potential mining of U.S. waters by non-state actors, which lessened in priority after the fall of the Soviet Union, must now be part of homeland defense priorities.

The psychological threat of using mines can also threaten assured access. “If you make an announcement that there are mines in the water, you’ve succeeded in 75 percent of your mission”, says former Rear Admiral Stephen Baker, a senior fellow with the Center for Defense Information.[60]

Figure 3 perhaps best summarizes the toll naval mines have taken on U. S. forces in the past 50 years.

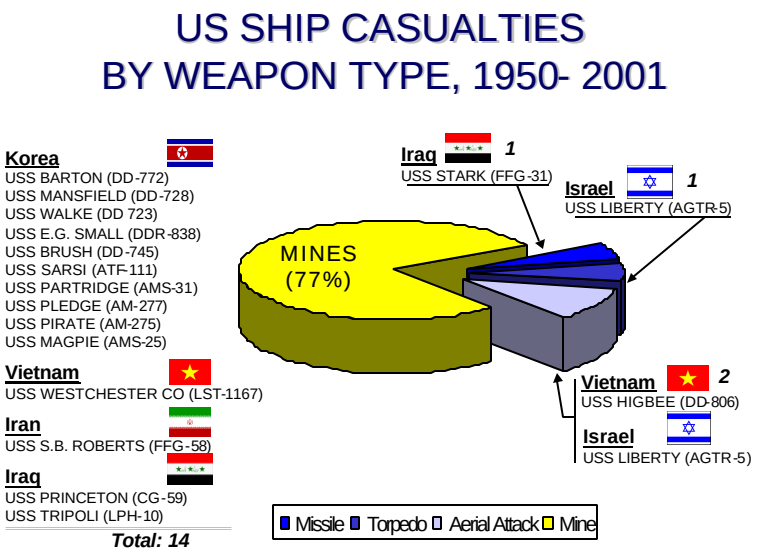

FIGURE 3 – U.S. MINING CASUALTIES[61]

Nearly 80% of U.S. ship casualties since 1950 have involved mines employed by inferior navies, a sobering fact that must remain at the forefront of naval strategic and operational planning. In a 1999 Mine Warfare Conference Speech, the Under Secretary of the Navy Jerry Hultin concisely summarized the current threat:

> …ask yourself how our nation would respond were a large number of our people were to die…if we lost a whole ship's crew to mines? What would be the reaction to the sinking of an LPD with its embarked marines? An entire operation might be shut down. Not by a great enemy dug in on the short with overwhelming advantage. No, the public opinion shift caused by a single mine --- an asymmetric threat --- could do the trick.[62]

CURRENT FORCE STRUCTURE

The current mine warfare structure consists of ship, helicopter and underwater assets, designed to operate as a "triad" against mine threats. Surface assets consist of fourteen *Avenger* class mine countermeasures (MCM) ships commissioned between 1987 and 1994. All are capable of conducting minehunting, minesweeping and mine neutralization operations. Twelve *Osprey* class minehunters (MHC's) capable of conducting only minehunting and mine neutralization operations, joined the force between 1993 and 1999. Two MCM's each are homeported in Sasebo, Japan and Manama, Bahrain, with two additional MHC's in Bahrain.

The remaining ships are all homeported in Ingleside, Texas. The Navy no longer has a dedicated command and control ship for MCM operations. The ex-USS *Inchon* (MCS 12) damaged by fire in 2001 was deemed too costly to repair and was decommissioned in early 2002. No dedicated mine warfare ships are stationed on either the Atlantic or Pacific coasts.

Airborne mine countermeasures (AMCM) assets consist of twenty MH-53 *Sea Dragon* helicopters, capable of conducting both minesweeping and minehunting operations. One squadron is stationed in Norfolk, Virginia and the other is located in Corpus Christi, Texas. Since 1999, four MH53-E's have been stationed in Bahrain, supported by rotational squadron personnel on four month deployments.

Underwater assets include explosive ordinance disposal (EOD) diver teams and marine mammal systems (MMMs) used to identify, neutralize and exploit mines. MCM EOD detachments are located in both U.S. and overseas locations, while the marine mammals are located in San Diego, California.

Three MCM tactical squadrons located in Ingleside, Texas, each consisting of 22 mine warfare experts, are rapidly deployable expeditionary squadrons on call to respond and support combatant commanders worldwide mine countermeasures operations.

The Commander of all mine warfare forces (COMINEWARCOM), a one-star admiral, is supported by a relatively small headquarters staff stationed in Corpus Christi, Texas. Additionally, the Mine Warfare Training Center (MWTC) provides sequenced course training in all aspects of mine warfare, while the Afloat Training Group (ATG) certifies shipboard tactical and doctrinal proficiency. Both commands are located in Ingleside, Texas.

The Commander of the Mobile Mine Assembly Group (COMOMAG), stationed in Corpus Christi, Texas, is responsible for all aspects of maintaining the U.S. stockpile of naval mines.

The current force structure provides ready assets supporting combatant commander operational plan requirements on the Korean Peninsula and in the Persian Gulf. While several surface units are permanently forward stationed in those regions, the remainder are all located in Ingleside, Texas. Getting these units to a crisis area requires sufficient warning time and strategic sealift. Senior Navy leaders recognize that transforming mine warfare capabilities must include quicker response times and increased force readiness.

BREAKING THE CYCLE – CAUSE FOR OPTIMISM

Much has been written on the common naval mine warfare problems of the past 225 years. Figure 4 below succinctly depicts these major cyclical themes.

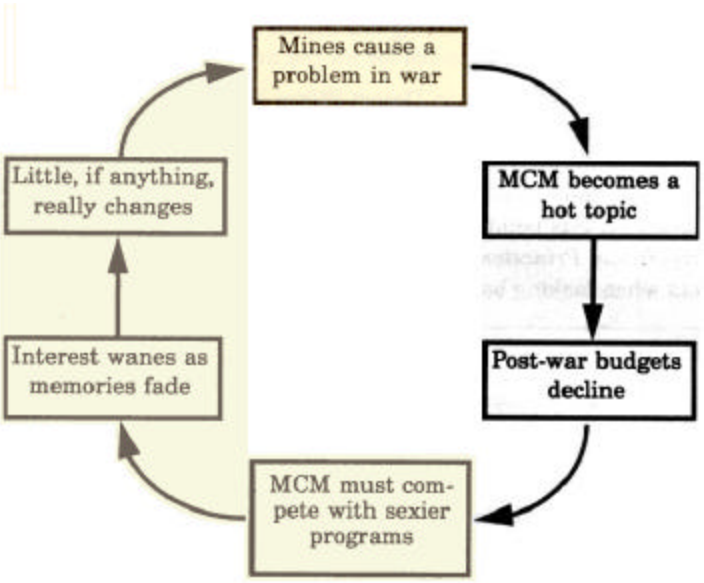

FIGURE 4 – THE VICIOUS MINE WARFARE CYCLE[63]

Lack of vision, inconsistent unity of effort, marginal readiness and budgetary pressures have plagued the U.S. mine warfare community from the Civil War through the Gulf Wars.

Today however, there are encouraging signs that senior DOD and Naval leaders may finally break this cycle of neglect. Realizing the current MCM force still lacks speed and mobility, Navy leaders are tackling this transformational requirement head on.

ESTABLISHING THE VISION

In June 2002 the Chief of Naval Operations, Admiral Vern Clark, provided clear vision in Sea Power 21 on how the Navy will organize, integrate and transform to meet global joint operational challenges from regional and transnational dangers. Sea Power 21 contains three main elements: (1) Sea Strike - projecting precise and persistent offensive power, (2) Sea Shield – projecting global defensive assurance and (3) Sea Basing – projecting joint operational independence.[64] The three main elements will be held together by Forcenet, integrating

warriors, sensors, command and control, platforms, and weapons into a networked, distributed combat force.[65]

Most encouraging in this vision is the inclusion of mine warfare as a key component in achieving Sea Power 21 success. The previous naval strategies "…From the Sea (1992) and "Forward … from the Sea (1994), while focusing on the littorals did not emphasize mine warfare as integral to implementing the strategy.

Admiral Clark realizes the importance of speed and mobility in mine warfare. During the 1987 Iran-Iraq War it took three months to prepare and tow six minesweepers to the Gulf. The 1990-1991 Gulf War required heavylifting three minesweepers to the Gulf on a one month voyage via Dutch transport at a cost of 1.6 million dollars.[66] The CNO's vision calls for embedding MCM capabilities in forward-deployed strike groups. New generations of sophisticated unmanned underwater vehicles (UUV's) will be part of both the dedicated and organic MCM forces, and will eventually link with unmanned air and surface vehicles via Forcenet to detect, avoid and neutralize mines at all depths.[67] The vision appears to be bold, sound and achievable.

UNITY OF EFFORT

History has repeatedly proven that U.S. mine warfare lacked consistent sponsorship and unity of effort. During WWII, then CNO Admiral Harold R. Stark rejuvenated interest in mine warfare out of necessity due to an increasing threat and marginal MCM capability. In 1970, then CNO Elmo R. Zumwalt, Jr., attempted to establish unity of effort by vowing to break the "unionized " approach to individual warfare areas by air, surface and submarine leaders. Secretary of Defense Cohen in the 1990's had to publish direct guidance to the Navy not to let current MCM capabilities degrade as it experimented with future organic MCM technologies.

While commendable, the results of these efforts were often fleeting due to a lack of buy-in and unity of effort. During his tenure, Admiral Clark has focused on improving unity of effort by realigning the Navy at all key levels. He has spearheaded efforts to streamline redundant staffs, eliminate conflicting priorities and instill fiscal discipline through process changes. While still encouraging healthy debate, there is little doubt that at the end of the day senior leaders now speak with one voice on major issues.

Sea Power 21 and mine warfare will benefit from realignment and this enhanced unity of effort. The CNO's 2003 detailed guidance to the force is published and priorities set. Sailors from Admiral to deck seaman realize the vision, priorities and expectations.

In a January 2003 Defense News interview, Admiral Robert Natter, the triple-hatted commander of the U.S. Atlantic Fleet, Fleet Forces command and the first naval component commander of U.S. Northern command spoke of the importance of priorities and unity of effort. Natter was also recently placed in charge of experimentation for the entire Navy:

> I've been very adamant about saying we're not going to endorse every pet rock somebody wants to push up to Washington. Because then we'll become irrelevant, and that was the problem before. Each fleet would provide their integrated priority list up to Washington. They'd get all this stuff and say, well, what are we going to do with all these priorities. And they became no priority. So this is an effort to funnel all this stuff through us. If in fact, we think there's some potential in it and it satisfies a valid war-fighting requirement, we establish it as a requirement and throw in into the programmatic process and push it.[68]

Admiral Natter further added that the Navy has directed Navy Warfare Development Command to focus their efforts on the two highest priority areas, mine warfare and anti-submarine warfare.[69]

The Navy is also reorganizing their acquisition community, further demonstrating the intention to streamline operations and strengthen unity of effort. Navy acquisition chief John Young, directed that on November 1, 2002 the Navy create a new single Program Executive Office (PEO) for ships, consolidating former officer for theater surface combatants, expeditionary warfare, mine warfare and undersea warfare and surface strike.[70] A new Deputy Assistant Secretary of the Navy (DASN) for littoral and mine warfare has also been established, combining the former office for mine and undersea warfare with that of expeditionary forces programs.[71] Young's changes are intended to "change from an approach that is optimized by program and platform to one that can solve the challenges of integrating systems that cross many platforms and functions."[72] By leveraging technology across various warfare areas, this reorganization should improve integration of future mine warfare platforms and systems with other naval combatants sensors and command and control systems.

BUDGET PRIORITIES --- MAKING THE HARD DECISIONS

Sea Power 21 provides the vision and outlines the direction the Navy will take to conduct future joint operations in the littorals. Transforming the force while deciding on the right type, design and mix of future combatants to achieve this vision is a daunting challenge, but one that senior Navy leaders are tackling head on. As the Navy's force structure continues to decline (308 ships as of 19 January 2003), it faces strong Congressional pressure to reverse the trend.

The Navy's challenge is not unlike the other Services, that is, to maintain enough legacy system capabilities to meet current needs while transforming the force without taking

unacceptable risk. It has elected to accept a degree of risk in order to meet future warfighting needs

Key to this transformation is accelerated design, testing, integration and production of the Littoral Combat Ship (LCS). The LCS concept calls for designing a high speed (possibly up to 50 knots) catamaran or trimaran vessel with small crews (20 to 100 personnel) and modular plug in components capable of conducting three main littoral missions: (1) mine warfare, (2) countering diesel submarines threats and (3) countering small surface craft. Vice Admiral Timothy LaFleur, the Navy's senior surface warfare officer, envisions a revolutionary platform in which a single joystick or console on the LCS's bridge can control a mine-hunting underwater drone or an unmanned boat, and if necessary, attack small craft threatening the LCS or the battle group.[73]

The Navy is moving out quickly and smartly on the LCS project. Six contractor teams recently submitted LCS design concepts and in early 2003, DOD will pick three designs for further refinement.[74] The Navy wants to start production in 2005 for fleet introduction in 2007 and build fifty to seventy LCS's at approximately $220 million dollars each, less than a quarter of the price of a new destroyer.[75]

The Army and Navy are already using a high speed vessel (HSV-X1) in joint operations. The HSV-X1 "*Joint Venture*", an Australian built shared Army and Navy joint asset was used to shuttle troops during operations in Afghanistan. The Navy used *Joint Venture* during exercise Millennium Challenge 2002, testing unmanned underwater vehicle's (UUV's) and experimenting with it as a mine warfare command and control platform The Navy will lease a second HSV in June 2003 and homeport it with other mine warfare ships in Ingleside, Texas to expand testing and integration.

Achieving the vision of Sea Power 21 requires tough budgetary decisions. In order to move out on the LCS concept, the Navy has decided to shed legacy systems quicker than originally anticipated. It intends to eliminate more than fifty programs and support systems, including accelerated decommissioning of the USS *Spruance* class of warships, F-14 fighter jets and S-3 anti-submarine warfare and refueling planes. Vice Admiral Mike Mullen, Deputy CNO for Resources, Requirements and Assessments, explains that by eliminating these legacy programs it "frees up billions of dollars that will enable us to buy more ships and aircraft and make additional transformational investments."[76] The CNO, Admiral Vern Clark asserts "we're overprogrammed and we're keeping too much stuff on life support … and we face more change in the next five years than we've seen in the last 25 years … if we do business as usual we won't get it done."[77]

The LCS concept is not without skeptics and critics. In order to field this transformational force current force structure may temporarily shrink below 300 ships. These small multi-mission ships are not envisioned to engage a blue water enemy but rather operate in the littorals. Critics contend that current proven capability is being sacrificed for unproven future concepts. But in order to make the vision of Sea Power 21 a reality, the Navy has decided to make tough budgetary choices now while accepting some degree of near to mid-term risk. Mine warfare is finally getting the attention it deserves. The vision, programs and resources will greatly assist in tackling mine warfare's historical age-old problems of speed and mobility.

MAINTAINING CURRENT MINE WARFARE ASSETS

Further proof of the Navy's commitment to breaking the historical cycle of neglect centers on the commitment toward maintaining the current dedicated mine warfare force structure. As described earlier, history has repeatedly shown that mine warfare programs and platforms are usually prime candidates for cuts and elimination during interconflict years. No ships have been damaged or sunk by mines since the 1991 Gulf War. But fortunately there are those in Congress who will not allow the Navy to renege on their commitment to improving mine warfare readiness. The FY-03 defense authorization bill requires the Defense Secretary and the Joint Chiefs of Staff to continue providing annual certifications of the adequacy of the Navy's mine countermeasures program through 2008.[78] The bill states the requirement "has had a positive impact on the program, increasing the visibility of and attention paid to the program by officials in the Department of Defense and the Navy."[79]

The Navy appears to be following through on this direction. The 14 *Avenger* class MCM's, 12 *Osprey* class MHC's and current fleet of MH-53E *Sea Dragon* mine countermeasures helicopters look as if they will remain in the force structure, at least until the LCS concept matures into proven capability in the 2005-2010 timeframe.

The Navy is also addressing current MCM fleet readiness, approving funding for replacing the maintenance intensive Italian made Isotta Fraschini diesel engines on MCM and MHC class ships. During congressional testimony Navy Secretary Gordon England contends that "the Navy remains committed to mine warfare" noting that the Service has continued to increase MCM funding throughout the Future Years Defense Program (FYDP) and has done so for the past five years.[80]

Still there are skeptics. When the Navy's only mine countermeasures command and control ship, the ex-USS *Inchon* (MCS 12) was damaged by fire in 2001, the Navy elected not to repair it. Critics immediately cited this an example of a wavering commitment to mine warfare.

Criticism such as this misses the mark. The *Inchon* was an old (29 years) ship, costly to maintain and operate. COMINEWARCOM prudently identified a temporary solution using another large deck amphibious ship, USS *Kearsarge* (LHD 3), as an interim command and control platform. Decommissioning *Inchon* freed up funds for future leasing and testing of HSV-X2's command and control capabilities in June 2003. The Navy appears committed to maintaining the dedicated force, while making the transition to organic battlegroup systems and future LCS capabilities.

CONCLUSION

In every major conflict the U.S. Navy experienced problems in countering the enemy sea mining threat. Less capable navies, lacking power projection or major strike capabilities, used mines as asymmetric weapons to affect U.S. strategic and operational planning. Sea mines today remain a serious threat to U.S. strategic interests in key regions of the world. Increasingly sophisticated, relatively inexpensive and widely proliferated, sea mines will continue presenting difficult challenges to the Navy's ability to guarantee assured access to critical regions.

The U.S. Navy today is at a crucial juncture in improving its mine warfare capabilities to counter this threat. Sea Power 21 provides the CNO's vision and outlines the steps required to make the vision a reality. Hard budget choices have been made and more will follow. Significant near-term force cuts of relatively young combatants such as the *Spruance* class destroyer, opens the window of opportunity to quickly develop the Littoral Combat Ship (LCS). These ships, combined with new organic systems due to enter the fleet in 2005, should provide the capability to rapidly respond to assured access threats in key regions. This improved capability is vital as a joint enabler for projecting dominant Army and Marine land power ashore.

While LCS is central to the Navy's vision of transforming the MCM force, it most likely will remain controversial and a target for skeptics critical of small, lightly armored and minimally manned ships. Designing fast, lightweight ships with enough survivability to operate in the littorals against cruise missile, small boat and sea mine threats poses technological challenges. Critics contend the Navy is downplaying these challenges and sacrificing near term blue water capability for unproven technologies.

For the near term the CNO and senior DOD leaders appear to have won the debate, accepting some risk while acknowledging the Fleet may drop below 300 ships until the LCS concept matures. Internal obstacles to LCS development will probably be minimal due to the CNO's move towards improving senior Navy and DOD unity of effort. However, should the LCS vision fall short in the long run due to technological and force integration problems, then the risk

increases. Though Admiral Clark says skeptics should not just look at total ship numbers, Congressional interest will most likely increase if the LCS falls behind schedule and total ship numbers do not increase as currently planned. Should this occur and development costs spiral upward, the Navy should guard against allowing current MCM capabilities and readiness to atrophy at the expense of LCS and organic systems development.

Improving current readiness and elevating mine warfare's importance as a primary mission area, are equally important to achieving Sea Power 21's vision as are future systems developments. The Navy has demonstrated a less than stellar track record at maintaining MCM capabilities when faced with budgetary pressures.

Though there most likely will be challenges in developing the LCS to maturity, it does appear to be the most promising solution to improving the Navy's long term force MCM capabilities. During the Gulf Wars, the Navy relied on old, marginally maintained 1950's vintage minesweepers to counter a significant mine threat in a region vital to U.S. security interests. If the Navy did not embrace improving MCM capabilities via the LCS concept, then it could face the same dilemma with the current MCM force structure later this decade. It has chosen to make the tough decisions now, in an attempt to break the historical cycle of neglecting MCM readiness until the next mining crisis occurs.

RECOMMENDATIONS

If the Navy remains committed to fully developing the LCS capabilities and successfully integrates future organic MCM systems, then the future does indeed appear bright for mine warfare. However, the LCS is still in early stages of development and organic systems have not yet entered the fleet. Near term needs should remain at the forefront. Following are several recommendations on areas requiring continued attention as the Navy charts its' course towards longer range Sea Power 21 capabilities.

RESIST SPLITTING THE FORCE

With the exception of 2 MCM ships home ported in Sasebo, Japan and 4 ships (2 MCM's and 2 MHC's) in Manama, Bahrain, the remaining U.S. surface mine force (20 ships) are all stationed in Ingleside, Texas.

There are pros and cons associated with having most of the mine force stationed in one location. The Navy's Mine Warfare Center of Excellence in Ingleside, Texas contains a state of the art training center. Enlisted minemen and officers detailed to mine warfare ships and staffs receive superb schoolhouse and at-sea practical training. The Center for Excellence also has maintenance facilities specifically tailored for maintaining mine warfare ships. This focused

maintenance effort has improved individual ship readiness. Rapidly deployable tactical MCM squadron staffs maintain proficiency during ship pre-deployment workups through a challenging fleet exercise program The synergy achieved by locating these forces in one location has improved day to day force readiness.

Despite the increased readiness posture, there are several significant cons in having most of the force located on the Gulf Coast. Participation in major fleet exercises with carrier battle groups (CVBG's) and amphibious ready groups (ARG's) on both coasts require long transit times, particularly to the West coast. In recent years, MCM ship participation in West coast exercises has been limited to every other year, while participation in East coast exercises has been more frequent. The simple matter of time and distance prohibits daily on-site interaction with Atlantic and Pacific Fleet ships.

Though the ships still participate in these exercises via electronic geo-translation simulations, some still see problems. Vice Admiral Herb Browne, then Commander of the U.S. Navy's 3rd Fleet homeported in San Diego, California commented in 1998: "As hard as I try with modeling and simulation, that just doesn't have the same impact of having them involved from the get-go… sailors and marines need to see them and their sweeping to appreciate the difficulties of mine warfare."[81]

Having most of the MCM assets stationed in Texas also poses homeland defense challenges. A credible terrorist threat or actual mining of a U.S. port would create economic havoc. In ports such as San Francisco or New York, current plans call for airborne MCM and EOD teams to be on-scene first responders within 2 to 4 days of a credible threat.[82] Arrival of follow-on surface MCM assets from the Gulf coast would take between 15 to 45 days.[83] This is clearly a concern and a challenge to the new Department of Homeland Security and U.S. Northern Command.

At first glance an easy solution to this challenge would be to split the force and strategically relocate some surface MCM assets to Naval bases in San Diego, Norfolk or Jacksonville. However, this course of action is not recommended.

First, splitting the force will negate gains made in force readiness. The Mine Warfare Center for Excellence concept has improved both the individual mine warrior's training and readiness as well as platform readiness. Crews work through a detailed inter-deployment training cycle and enter deployment windows to meet combatant commanders' operational plan requirements. This should remain the first priority --- forces trained and ready through common tactics, techniques and procedures. The current command, control and in-place training structure best supports this requirement.

Second, having MCM assets physically on-scene participating in every major fleet exercise is not necessary. While every CVBG and ARG commander ideally desires on-scene support during pre-deployment exercises, this would place unnecessary demands on MCM ships primarily designed for overseas contingencies. It is more important for the commander and his staff to appreciate the risks and timelines associated with mine hunting and clearance operations, rather than seeing “ships on the horizon” actively sweeping and hunting. Much of this can and should be accomplished through modeling and simulation, keeping the MCM forces ready for contingencies.

Third, the homeland defense issue is much larger than simply the availability of MCM assets in U.S. ports. The strategy needs to include all aspects of intelligence gathering, commerce source inspection and enroute tracking, interagency cooperation and pre-planned responses. Until this strategy matures, MCM forces should remain in their current locations. Airborne mine countermeasures and EOD assets located in Norfolk, Virginia and Corpus Christi, Texas should remain integral to first responder plans.

Finally, though it is prudent to keep the current MCM force disposition in place, this should not necessarily be the long term solution. As the LCS concept matures and ships enter the fleet later this decade, the Navy should carefully examine future homeporting strategy. The answer to the above issues may very well lie in homeporting LCS’s on the East, West and Gulf coasts. The Mine Warfare Center of Excellence can remain the hub for central mine warfare training and future requirements issues, with stronger links to the east and west coast major fleet concentrations areas.

CONTINUE “MAINSTREAMING” MINE WARFARE

In 1998 the U.S. Navy implemented a Fleet Engagement Strategy designed to increase (“mainstream”) naval planners mine warfare operational knowledge. The goal is to make mine warfare as important to the CVBG or ARG commander as more traditional warfare areas, such as strike or air warfare. So far some progress has been made but more needs to be done.

Historically, the mine warfare problem has been a mine warfare community problem and not a fleet problem. Battle groups tended to rely more on dedicated mine warfare experts solving the problem, rather than building mine warfare operational knowledge requisite to their own staffs. This has slowly started to change, and it will become more important as the organic systems enter the fleet in 2005. Deploying CVBG’s and ARG’s will be equipped with their own limited mine hunting and mine avoidance capabilities. Operational and tactical mine warfare expertise should be inherent to future deploying battle groups.

Today each deploying CVBG and ARG is certified in mine warfare during the inter-deployment training cycle and pre-deployment joint task force exercises. Still, some fleet exercises continue underestimating the effects of mines on operations. Time lines have been artificially shrunk to overcome delays caused when exercise mines are encountered or units striking mines are unrealistically quickly reconstituted.[84] In order to stay within the scripted exercise timeline, the full effects of mine encounters may not be realized by the operational planners. This tends to foster the belief that mine damage is either imaginary or can be ignored as a real strategic or operational planning factor.[85]

The current pace of naval operations and rapid turn around of deploying battle groups only exacerbate the problem Exercise planners and evaluators should ensure there is consistent rigor built into the process. At the very least, every commander and principal staff planner should come away from their final pre-deployment certification with an appreciation for the mining risks, knowledge of their effects on operational timelines and need for assets required to counter the problem. Mainstreaming mine warfare while adding organic MCM capabilities are critical to the ability of future CVBG's and ARG's to attain and maintain sea battlespace dominance.[86]

CONTINUE PROFESSIONAL FORCE DEVELOPMENT

History proves that mine warfare as a profession has taken a back seat to other U.S. Navy warfare areas. Forces were mobilized as needed, capabilities restored and ships built to meet the threat as it developed. Maintaining a standing professional mine warfare force comparable in stature to other warfare professionals has been a recurring problem.

Today the U.S. Navy's mine warfare enlisted force is among the best in the world. In the mid-1990's, the Navy restored the mineman rating, combining several other rates (operations specialist, sonarman, boswainmate) into one. The results of this merger so far are promising. Enlisted sailors receive technical and operational training comparable to other warfare areas. As future organic systems and the LCS enter the fleet, minemen will be central to their tactical employment. Attracting the best and brightest talent to operate these increasingly complex systems should prove challenging.

Officer expertise and training, while getting better, still has room for improvement. Mainstreaming mine warfare will only be effective if more officers perceive expertise in mine warfare as career enhancing.[87]

For officers, there is still a stigma attached with spending too many tours in mine warfare. Junior officers view duty on carriers, cruisers and destroyers as more exciting and career

enhancing. They tend to promote at higher percentages than their counterparts who spend significant time in mine warfare billets. Commanding officers of MCM's and MHC's are a major exception to these promotion trends. These officers at the rank of 0-4 (LCDR) are exceptionally talented and hand picked to command. The vast majority screen for promotion and 0-5 surface command. Still, among this talented group, few tend to seek follow-on mine warfare billets. There are few upwardly mobile 0-6 mine warfare community billets, a fact not unnoticed by these top-notch junior officers.

In order to further mainstream mine warfare, the Navy should tap these former commanding officer's expertise and place some in key battle group and fleet staff billets. Former MCM and MHC commanding officers are prime candidates for operational billets on these deploying staffs. The Navy should prove to these officers that their time learning mine warfare was not just a one time occurrence used as a stepping stone for future command.

The LCS will also enhance the mine warrior's image. Plodding along at 8 knots on today's MCM and MHC's will pale in comparison to zipping around at 40-50 knots on an LCS conducting integrated battle group multi-mission operations in the world's littorals.

CONCLUDING COMMENTS

As Sea Power 21 concepts mature, the Navy must retain and improve the current dedicated mine warfare force of ships, helicopters and underwater assets. Service competition will most likely increase as each strives to meet their own transformation goals. DOD and Navy leaders should remember the cycle of neglect and recall how mine warfare has traditionally fared in resource competition battles.

The Navy has made some positive advances in increasing mine warfare knowledge throughout the fleet, but more needs to be done before it can be considered equally important as other warfare areas. Greater rigor in pre-deployment certifications and assessments and more in-grained battle staff expertise is required.

If the U.S. becomes involved in a conflict with Iraq and sea mines are not used, it should be careful not to draw broad conclusions over the need to press forward with improving mine warfare capabilities. The Iraqi Navy today is a small, weak force shattered by Desert Storm with almost no anti-surface ship capability.[88] It has one operational missile boat, five non-operational inshore patrol craft, one non-operational training frigate and two ships stranded in Alexandria, Egypt and La Spezia, Italy.[89] The Iraqi Navy, crippled by sanctions pales in comparison to other potential adversaries such as Iran, North Korea and China. As history has repeatedly shown, it is not a matter of if sea mines will be used in future conflicts, but simply a matter of when.

The U.S must retain a capable MCM force. Today's strategy appears sound, but achieving the long term vision requires continued commitment by Congress, DOD and Navy leaders. They must "stay the course" and avoid falling back into the traditional mine warfare cycle of neglect.

WORD COUNT=9,216

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GLOSSARY

AMCM	AIRBORNE MINE COUNTERMEASURES
ARG	AMPHIBIOUS READY GROUP
COMINEWARCOM	COMMANDER, MINE WARFARE COMMAND
CNO	CHIEF OF NAVAL OPERATIONS
CVBG	CARRIER BATTLE GROUP
DOD	DEPARTMENT OF DEFENSE
EOD	EXPLOSIVE ORDNANCE DISPOSAL
LCS	LITTORAL COMBAT SHIP
MCM	MINE COUNTERMEASURES
MHC	COASTAL MINEHUNTER
MSB	MINESWEEPING BOAT
MSO	OCEANGOING MINESWEEPER
UUV	UNMANNED UNDERWATER VEHICLE

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