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14. ABSTRACT

Mine Warfare (MIW) has been a traditional weakness of the U.S. Navy. The affordability of mines, their destructive power and wide proliferation coupled with the requirement for the U.S. Navy to operate in the littorals requires drastic improvements to U.S. Mine Warfare. In order to support operational timelines, forward deployed naval forces need Mine Countermeasures systems resident within Strike Groups to counter enemy mine laying activities. Additionally, the Navy needs to transform its culture and mainstream the full spectrum of MIW to include naval mining and countermine warfare capabilities. Only then will Joint Force Commanders be able to control the battlespace, operate unfettered in littoral areas and pass freely through critical choke points to execute operational plans.

The U.S. Navy needs to transform its culture and mainstream MIW through doctrine, training, education, and leadership. In addition to elevating MIW to a core war fighting function with an established MIW Commander, formalizing MIW doctrine, establishing a base level of knowledge among the officer corps and incorporating realistic MIW Strike Group work-ups, the Navy must also ensure that MIW assignments are career enhancing and attract top performers across the spectrum of officer communities. A MIW force, capable of overcoming the vulnerabilities exposed by the Gulf War, requires the synergy of technological advancements and culture change.

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MINE WARFARE—THE JOINT FORCE COMMANDER'S ACHILLES HEEL

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract

Mine Warfare (MIW) has been a traditional weakness of the U.S. Navy. The affordability of mines, their destructive power and wide proliferation coupled with the requirement for the U.S. Navy to operate in the littorals requires drastic improvements to U.S. Mine Warfare. In order to support operational timelines, forward deployed naval forces need Mine Countermeasures systems resident within Strike Groups to counter enemy mine laying activities. Additionally, the Navy needs to transform its culture and mainstream the full spectrum of MIW to include naval mining and countermine warfare capabilities. Only then will Joint Force Commanders be able to control the battlespace, operate unfettered in littoral areas and pass freely through critical choke points to execute operational plans.

The U.S. Navy needs to transform its culture and mainstream MIW through doctrine, training, education, and leadership. In addition to elevating MIW to a core war fighting function with an established MIW Commander, formalizing MIW doctrine, establishing a base level of knowledge among the officer corps and incorporating realistic MIW Strike Group work-ups, the Navy must also ensure that MIW assignments are career enhancing and attract top performers across the spectrum of officer communities. A MIW force, capable of overcoming the vulnerabilities exposed by the Gulf War, requires the synergy of technological advancements and culture change.

Introduction

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

Admiral Forrest P. Sherman, the Chief of Naval Operations 1949-1951, made this observation following the heavy losses of five ships and over 200 casualties off the coast of Wonson, Korea in October of 1950.[i] He would be amazed to discover that fifty-four years later, despite the increased risk that mines present in the littoral regions and choke points, Mine Warfare (MIW) remains a subsidiary branch of the Navy. Since 1950, mines have sunk or damaged 14 U.S. Navy ships,[1] while missile or air attacks accounted for damage or sinking of two naval ships.[ii] While the United States Navy has made substantial technological improvements to its Mine Warfare[2] forces over the last fifty years, it has not kept pace with global MIW improvements for both offensive mining and countermine warfare (CMW). Mines are affordable weapons and, as such they have been widely distributed and continue to pose a significant threat to U.S. Navy plans to conduct sea control operations as required by Title 10 of U.S. Code.[iii] Mine exporting countries such as Russia, Italy and Sweden supply technologically advanced mines to more than fifty countries, a 75% increase over the last fifteen years. [iv, v] Furthermore, U.S. Navy culture has failed to embrace MIW as a core function, and has failed to groom officers with a base level of knowledge and spread them throughout the Fleet.

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[1] See Appendix A.

[2] For this paper, Mine Warfare includes naval mining and countermine warfare. Countermine warfare encompasses the full spectrum of assets available to prevent mines from damaging ships and includes intelligence and other support activities important to countering the threat of mines. Additional subsets to countermine warfare are mine countermeasures (MCM). There are both active MCM operations—hunt and sweep to clear mines—and passive MCM operations—ship self-protection techniques such as reducing the magnetic and acoustic signature. See Appendix B.

The United States attempted to recover from its extended neglect of the MIW forces following the Gulf War by investing 226 million dollars in organic[3] mine countermeasures (MCM) technology from 1999 through 2004.[vi] The intended product of this investment is deployed U.S. Navy Strike Groups with the capability to accomplish "in stride" mine clearance without awaiting the arrival of dedicated MCM forces which would cause an unacceptable delay to operational timelines in an environment of speed and maneuver warfare. Organic MCM systems leverage advanced technology and will be forward deployed with Carrier Strike Groups and Expeditionary Strike Groups. These organic systems should provide Joint Force Commanders with rapid and "assured access"[vii] to littoral areas. However, success across the broad spectrum of MIW—offensive mining and countermine warfare—requires support and capabilities that organic systems alone cannot provide. To most effectively harness the burgeoning organic MCM technology, these new systems must be blended with the existing dedicated systems. This synergy would allow Joint Forces to rapidly access contested areas with the organic systems and to sustain that access with the follow-on dedicated systems.

More importantly, however, the Navy must transform its culture and recognize MIW as a core Navy war fighting function. Formalized doctrine and well trained forces that are regularly exercised and integrated with Fleet operations should accompany this transformation. MIW knowledge should not be limited exclusively to an isolated band of brothers, but rather should be cultivated as part of the war fighting knowledge of line officers throughout the Fleet.

[3] Organic MCM refers to the new systems scheduled to enter service and deploy with Carrier and Expeditionary Strike Groups beginning in FY05. See Appendix C for a full listing of the systems.

The United States' lack of MIW preparedness is even more alarming considering the dramatic world changes over the last fifteen years. The fall of the Soviet Union and the end of the Cold War left the United States as the sole super power with a powerful Navy, unchallenged in the blue-water environment. In order to support forcible entry operations, it is essential that the U.S. Navy have the ability to operate unfettered in the littorals and to pass freely through critical choke points. This capability "allows future joint force commanders to retain operational freedom of action and gives the United States the ability to go anywhere that U.S. interests require."[viii] Furthermore, the rise of terrorist attacks since the end of the Cold War has drastically altered the threat to U.S. ships all over the world. U.S. ships operating in littoral areas are vulnerable to attack by mines from not only nation-states but also terrorist groups.[ix] Joint Force Commanders find themselves on the horns of a dilemma: they must dominate the littoral environment, but this is precisely where U.S. forces are the least prepared and the most vulnerable.

Historical Perspective from the Gulf War of 1991

Operations as recent as Desert Storm demonstrate U.S. MIW unpreparedness and the profound impact to coalition operations. In the Gulf War of 1991, the extent and effectiveness of the Iraqi mining operations surprised coalition forces and exacted a costly toll on U.S. Navy warships and prestige. On 18 February 1991 USS *Tripoli* (LPH 10), an amphibious carrier conducting mine clearance operations, struck a moored contact mine 50 nautical miles off the coast of Kuwait.[4] This unsophisticated weapon blasted a 16-by-25 foot hole in the *Tripoli* hull.[x] Only the heroic damage control efforts of the crew allowed the ship

[4] Iraq benefited from its long relationships with the Soviet Union and other communist countries through military hardware and technology support. The USS *Tripoli* struck an Iraqi made LUGM-145 mine. The LUGM-145 is a copy of the Soviet M-08 which entered Soviet service in 1908. Samuel Loring Morison, *Guide to Naval Mine Warfare* (Arlington, VA: Pasha Publications Inc. 1995), 98.

to remain on station for three days before entering a Bahraini shipyard for repairs. Less than three hours after the *Tripoli* incident and only 10 nautical miles away, USS *Princeton* (CG 59), a state-of-the-art Aegis cruiser providing air defense for mine-hunting ships, actuated at least two bottom influence mines.[5] The extensive damage to the keel and superstructure forced the ship out of the battle.[xi] These asymmetric weapons cost the Iraqis only $11,500, but inflicted approximately $27.5 million dollars in damage to U.S. ships,[xii] damaged American prestige, and drastically altered the Joint Force Commander's options.

The Navy's vulnerability to the Iraqi minefields and the inability to clear them contributed to the Joint Force Commander's decision to cancel the planned amphibious assault at Ash Shuaybah, Kuwait. This restriction limited the Commander's options, reduced the lethality of the joint combat force, and forced him to accept greater operational risk. U.S. Navy ship casualties during Operation Desert Storm demonstrated the profound force multiplying effect of a mining capability and highlighted the United States' weakness in countermine warfare.

An examination of recent U.S. conflicts from a naval mining perspective reveals further atrophy of U.S. MIW capabilities. In the Vietnam War, mining operations proved to be highly effective. In 1972 the U.S. halted the delivery of war material to Vietnam for over 2 years by mining Haiphong and other harbors on the North Vietnamese coast.[xiii] In contrast, during Operation Desert Storm the U.S. Navy made only one attempt to lay mines. On 18 January 1991 four A-6 Intruders laid 42 mines. The Iraqis shot down one of the aircraft and the minefield was not reseeded. Ultimately, the limited minefield had little effect on Iraqi

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[5] Influence mines may utilize any combination of acoustic, magnetic, pressure or seismic signatures that accompany all surface vessels and submarines. These mines are usually placed on the ocean floor and discriminate between targets based on the type of signature the mine "senses." Italy sold hundreds of these mines to Iraq prior to the Gulf War and it was this type of mine that *Princeton* actuated. Samuel Loring Morison, *Guide to Naval Mine Warfare* (Arlington, VA: Pasha Publications Inc. 1995), 103.

operations.[xiv] Traditionally, the Navy did not hold mining in high regard and quickly abandoned any attempts to reseed or expand the minefield. While geographic and political considerations might have accounted for the limited use of mines in the Gulf War, offensive mining is an option Joint Force Commanders should have available in any conflict. The ineffective mining operations conducted by the United States in the Gulf War further highlighted U.S. weakness in MIW.

The Way Ahead

The Gulf War provided valuable lessons to the Navy about the nature of mine warfare and the improvements necessary to counter this asymmetric threat. First, political restrictions and on-going negotiations may prevent the overt interdiction of enemy mine-laying infrastructure such as striking mine storage facilities, transportation nodes or port facilities. Therefore, until the Rules of Engagement and the political situation allow interdiction, an understanding of the depot-to-sea mining process and a fusion of intelligence regarding the status of mine laying indicators, such as movement from storage facilities to ports, are paramount.[6] The Joint Force Commander must be aware of these requirements and their importance to the success of the entire operation. Second, on-station forces must have the capability to conduct MCM operations "in stride" in order to support the timelines for operational plans, maintain operational tempo, and immediately respond to emergent threats.

Lastly, the U.S. should invest in its offensive mining capabilities. Future naval operational concepts such as Sea Basing and network centric warfare will eventually provide ideal applications for a capable offensive mining force. Advanced, controllable mines could effectively shape the battlefield and allow Joint Force Commanders to more efficiently utilize limited naval resources to exploit the factor of space. The use of defensive minefields could

provide a viable means to control the battlespace without tying-up valuable surface ships. These ships could then be released to conduct other missions such as Tomahawk strikes, anti-submarine warfare, or theater ballistic missile defense.

In contrast, some may argue that the "national will" issues typically involved with the use of naval mines—safety of the minelayer, lack of precision, and weapon control—will prevent the United States from employing such weapons, rendering further investment in naval mines futile.[xv] However, these "national will" issues could be solved by leveraging existing technology to improve offensive naval mining capabilities. For example, the application of global positioning system (GPS) technology to naval mines through the development of a mine version of the joint direct attack munition (JDAM)[xvi] could mitigate the risk to the mine-layer by allowing weapon delivery from a safe stand-off distance. Additionally, the use of GPS technology with naval mines could precisely place the weapons. Lastly, existing technology in the Mk 71 Target Detection Device (TDD) is approaching the level of control needed for naval mines. To fully satisfy the control requirements, existing technology in Versatile Exercise Mines (VEMS) that provides two-way communications from the surface to the mine could be combined with the Mk 71 to remotely control features such as arming and disarming, target detection settings, and neutralization.[7] The further development and application of this technology would allow Joint Force Commanders to more efficiently utilize naval forces to effectively control the battlespace.

Furthermore, in order for the organic and dedicated MCM initiatives to succeed and respond to new technology, the U.S. must be a leader in mine technology. Unfortunately, as noted by the Committee for Mine Warfare Assessment, "The current U.S. naval mining

[6] Phases 1 and 2 listed in Appendix B encompass these functions.
[7] Appendix D describes the capabilities of the Mk 71 TDD, VEMS, and the U.S. mine inventory.

capability is in woefully bad shape with small inventories, old and discontinued mines, insufficient funding for maintenance of existing mines, few funded plans for future mine development (and none for acquisition), declining delivery assets, and a limited minefield planning capability in deployed battle groups."[xvii] Moreover, the United States should possess a capable, robust mine inventory as a viable deterrent to the use of mines by potential adversaries.

MIW Application to Sea Power 21. The Chief of Naval Operations (CNO) outlined his vision for the Navy's future in Sea Power 21 and stated, "the sea will provide a vast maneuver area from which to project direct and decisive power around the globe."[xviii] Sea Shield, along with Sea Strike and Sea Basing constitute the three pillars of Sea Power 21. In the CNO's vision, Sea Shield will project global defensive assurance and, among other objectives, provide sea and littoral superiority, the enabling of forced entry, and sustained access. MIW, a historical weakness, is the "linchpin"[xix] to the success of these objectives. In order to remedy this weakness, many investments have been made to bring organic MCM technology to the Fleet.

Some may point to this emerging organic MCM technology and the recent success of MIW in Operation Iraqi Freedom (OIF)[xx] and argue that the previous shortfalls in countermine warfare have been overcome. However, the organic MCM technology is unproven. Furthermore, the successful OIF MCM operations have to be qualified. Two of the 14 available Avenger Class Mine Countermeasures Ships (MCM) and two of the 12 available Osprey Class Minehunter Ships (MHC) have been forward based in the Persian Gulf since 1995 where they have conducted extensive bottom mapping and environmental studies. Since the end of the Gulf War of 1991, intelligence, surveillance, and

reconnaissance (ISR) assets have provided better understanding and have localized the Iraqi mine infrastructure and capabilities. Additionally, the decade of sanctions, no fly zone enforcement and maritime intercept operations combined with the destruction of the Iraqi navy in the first Gulf War prevented the Iraqis from conducting extensive mine laying operations in 2003. This decade-long battle space preparation set the conditions for the brave men and women of the MCM force to succeed in clearing the mines from the Iraqi waters. In spite of the increased visibility and the expectation of the use of mines in OIF, Iraq was still able to put mines in the water using tugs and converted barges. Their techniques were deceptive, clever, and cheap and proved that any vessel can be a minelayer. While the clearance effort was confined to a relatively small area, it once again proved to be costly in both time and effort.

Unfortunately, a number of strategic areas such as the Taiwan Strait, Sea of Japan, Korea Strait, and Strait of Malacca,[xxi] where the U.S. has minimal battle space preparation, are vulnerable to mining operations by potential enemies. Therefore, despite the recent successes in OIF and the investments in organic MCM technology, further transformation is required in order to meet the objectives of Sea Power 21 and translate the MIW lessons learned from the Gulf War into improved global capabilities.

The Navy culture that transitioned from the 1986 Cold War "Maritime Strategy" to a Strike Warfare focus with "…From the Sea" in 1992 and "Forward…From the Sea" in 1994 must transform further and align with the CNO's vision for the 21st century. Moreover, a culture change that leads to the mainstreaming[8] of MIW through doctrine, training, education, and leadership needs to accompany the burgeoning technology in order to elevate

MIW and fulfill the requirements of Sea Shield. Only this synergy of technology and people will allow the Navy to overcome its MIW shortfalls and realize the CNO's vision of Sea Power 21.

Culture Change—Mainstreaming the Full Spectrum of MIW

According to Admiral David Farragut, "I have always deemed it (the use of naval mines) unworthy of a chivalrous nation, but it does not do to give your enemy such superiority over you."[xxii] Despite the effective use of mines by the U.S. in Haiphong Harbor during the Vietnam War, Admiral Farragut's view of the use of offensive naval mines persists as evidenced by the negligible mine warfare budget relative to other [strike] missions and the antiquated state of the U.S. mine inventory.[xxiii] Furthermore, the isolation of today's MIW community fosters a culture that CMW is "somebody else's problem." This perspective leads to a reactive "9-1-1" mentality for mine clearance operations—the only naval warfare area where the accepted operating practice is to "bring in the experts."[xxiv] From either a naval mining or a countermine warfare perspective, Navy culture is a significant barrier to the acceptance of MIW as a core war fighting function.

Culture change, in any organization, is a daunting challenge. Culture change in an organization such as the U.S. Navy, which celebrates its rich heritage and tradition, proves to be even more difficult. The driving force to overcome this cultural inertia must be the mainstreaming of MIW. The Fleet Engagement Strategy (FES) of December 1999 provided a "roadmap"[xxv] to mainstream MIW, but was not rapidly implemented.[xxvi] The FES neglected offensive mining capabilities as well as other operational considerations. In addition to the four pillars identified in the FES—doctrine and tactics, education and training,

[8] "The term mainstreaming refers to the Navy's plan to elevate naval forces' level of CMW understanding, bring CMW planning considerations to the forefront, and prepare naval forces to integrate organic systems into

industry and technology, and public affairs[xxvii]—mainstreaming must also include elevation of MIW to a primary warfare commander, common knowledge base, and career enhancing assignments. Furthermore, this culture change will not succeed unless naval leadership embraces and promotes the MIW Campaign Plan which is designed to mainstream the MIW technology, expertise and awareness.

Mine Warfare Commander. The scope of the U.S. Navy's MIW responsibility includes the protection of all U.S. military forces at sea, logistics transports, Marine Corps units, sea lanes, ports of embarkation and debarkation, and amphibious assault areas to the high water mark.[xxviii] The operational significance and the scope of this responsibility require oversight by a primary warfare commander within the Composite Warfare Commander (CWC) structure. Furthermore, as the organic technology matures and begins to deploy (first deployment expected in FY05)[xxix], a commander, at the Carrier and Expeditionary Strike Group staff level, needs to have the expertise to plan and direct the efforts of multiple surface and air assets resident throughout the CSG/ESG. Additionally, when dedicated MCM assets reach the theater, the CSG/ESG MIW Commander (MIWC) would assume operational control (OPCON) of these forces. A permanent MIWC, commensurate with the Air Defense Commander (ADC), Sea Combat Commander (SCC), and Air Combat Commander (ACC), would be responsible for the coordinated execution of the MIW plan (offensive mining as well as countermine operations) in support of the Joint Force Commander's operational plan. The creation of a MIWC would establish a streamlined MIW command and control (C^2) structure and, as stated in the *Mainstreaming MIW and the Transition to Organic MCM Capabilities—Implementation Plan*, would enhance the efforts to elevate MIW.

CSG/ESG operations to provide on-scene CMW capabilities.

A Mine Warfare Commander, embedded in the "war fighting command staffs"[xxx] would help to mainstream MIW by providing the appropriate level of command experience, gaining the necessary level of attention, and routinely exposing the officer corps to MIW operations to raise their level of awareness and establish a common knowledge base. A key to the establishment of this common level of knowledge is the integration of the MIWC with the other strike group operational commanders throughout the training cycle. Admiral Boorda's 1995 MIW white paper set a mid-term goal (by 2003) of routinely exercising MIW skills in regular exercises. Contrary to the former CNO's goals, strike groups currently receive little or no MIW training during the work-up cycle. The token MIW training which strike groups do receive is typically an adjunct to a scheduled exercise with only notional support from MCM forces in Ingleside, Texas. Furthermore, the MIW objectives have little or no impact on the success of the overall exercise. Consequently, the attitude toward MIW training is that the MIW forces ought to stay out of the way and conduct some notional unit level training as long as it does not impact any strike group training evolutions required for certification. To overcome this attitude, MIW training must be included early in the strike group training cycle, reinforced in every subsequent work-up exercise, and assessed as a highly valued and required skill set necessary for every strike group deployment.

Education and Training. The mainstreaming of MIW requires that officers of the Navy and Marine Corps receive a foundation of core MIW knowledge as a part of the accession pipeline that establishes an early awareness of the threat and is developed throughout a career. Just as with any war fighting skill, the initial training should be cultivated and ingrained with practical application and continuing education at all levels of command. The full spectrum of MIW considerations including mining, MCM and self-protection measures

should become second nature. MIWCs should no longer discover that only 60 percent of Cruiser Commanding Officers understand that half-shaft RPMs is a self-protection measure against influence, bottom mines.[xxxi] With early MIW training and experience, MIW skills will be cultivated throughout the officers corps. Therefore, at a minimum Navy and Marine Corps officers should possess a basic level of MIW knowledge in order to fully appreciate the impact of the problem and have the ability to formulate possible solutions and pre-planned responses.

Doctrine. MIW cuts across not just Navy communities, but also across Services. With the advent of organic MIW systems, all surface warfare officers and submariners will be exposed to platforms with MCM applications. Naval aviation participates in the laying of mines with the F/A-18, F-14, and P-3C as well as the hunting and sweeping of mines with the MH-53 and its successor, the MH-60S. The Air Force participates in mine laying missions with the B-52H, the B-1B, and the B-2.[xxxii] Lastly, the Marine Corps supports mine clearance missions in the very shallow water zone (40 ft to 10 ft) and interfaces with the Army to clear mines landward from the high water mark.

In order to facilitate cross-service understanding of MIW, the Navy needs to establish accepted doctrine. Current Naval Warfare Publications do not reflect the full scope of the issues involved with MIW. For example, Commander, Fifth Fleet included the term countermine warfare (CMW) in the MIW framework for Fifth Fleet. The Committee for Mine Warfare Assessment, chartered by the CNO in 2000, adopted this terminology. CMW includes five phases,[9] of which the first four are intended to keep mines from reaching the water. This updated framework more effectively identifies the resources necessary to conduct MIW operations. However, current Naval Warfare Publications do not address

CMW or its first four phases. In order to mainstream MIW, the Navy should update and formalize MIW doctrine that accurately reflects the breadth of resources required for MIW and eliminates the disparity between doctrine and practice.

Some may argue that the localized nature of the MIW threat—primarily in the littoral region—is not significant enough to require a culture change in the Navy and that the emerging organic MCM technology will allow naval forces to avoid the MIW threat. However, the littorals and strategic choke points are precisely where joint force commanders require naval forces to operate. Furthermore, according to the Committee for Mine Warfare Assessment, "the greatest problem [with organic MCM systems]…is the lack of a systems concept and approach toward integrating these systems into the fleet and using them operationally."[xxxiii] Mainstreaming MIW through doctrine, education and training provides an over-arching strategy and the establishment of a permanent MIWC provides the means to operationally integrate MIW forces. Lastly, given the strategic significance of post-hostility requirements, it is essential that the United States retains the ability to clear strategic ports, waterways and approaches for the delivery of humanitarian aid, equipment and other commodities in order to rapidly restore stability.

Career Enhancing Assignments

"For mainstreaming of mine warfare to be fully effective, officers must perceive expertise in mine warfare as career enhancing. To this end, a desirable promotion path is needed for officers who have devoted career time to gaining expertise in mine and countermine warfare."[xxxiv] The Committee for Mine Warfare Assessment, convened by the CNO in August of 2000, noted that due to the limited career opportunities for officers with MIW experience, a "well-justified belief"[xxxv] exists that MIW is a niche capability that limits an

[9] Appendix B lists the Phases of CMW.

officer's exposure to other warfare areas and results in limited future assignments and negatively impacts an officer's possibility for promotion. Therefore, the culture change to mainstream MIW should recognize MIW as a discipline vital to the Navy's ability to conduct sea control operations as required by Title 10 of U.S. Code and envisioned by the CNO in Sea Power 21. As summarized by the Committee for Mine Warfare Assessment, "Until naval personnel are fully qualified and knowledgeable in the mine warfare area, and are able to advance their careers from such an orientation, there will be little hope of raising mine warfare into the mainstream."[xxxvi]

In 2001, the Navy reportedly made attempts to reverse the perception that MIW was a "second class"[xxxvii] assignment by detailing some of its most capable junior officers to command the Navy's mine hunting and mine sweeping ships.[xxxviii] This commitment of personnel resources should advance the Navy's attempts to change its culture. However, the impact of this resource investment on the Navy's culture will only come from an assessment of the long-term effects to the careers of these talented officers. In the meantime, another method to demonstrate the Navy's commitment to MIW and culture change would be to place greater emphasis on MIW expertise for the selection of flag officers from all communities—surface warfare, naval aviation and special operations. Additionally, MIW expertise "should become an explicit prerequisite for such key operational commands as Commander, Mine Warfare Command."[xxxix] Culture change can only occur when the MIW community is able to offer career enhancing assignments that attract top performers.

The success of the Navy's ambitious attempts at culture change rests with the support that senior naval leaders offer to the effort to mainstream MIW. To overcome the inertia of an organization that traditionally viewed MIW as a "second class" discipline will require strong,

innovative leadership. The CNO took the crucial first step by outlining his vision in Sea Power 21 and emphasizing the importance of MIW to the concept of Sea Shield. This emphasis by the CNO should elevate MIW to a core war fighting function with an established MIW Commander in every Carrier and Expeditionary Strike Group, integration of updated MIW doctrine, core training for all officers, incorporation of realistic MIW training in Strike Group work-ups, and establishment of viable career paths to officers with MIW expertise.

Recommendations

- Continue to develop organic technology, but invest in improvements to dedicated MCM capabilities.
- Develop naval mining capability. Apply existing GPS technology to mining applications to solve the issues of mine-layer safety and precision. Further develop the existing Target Detection Devices to include two-way communication capabilities in order to solve the weapon control issues.
- Dedicate the necessary ISR assets to the tracking of MIW infrastructure to keep mines from entering the water. Additionally, increase the priority for the information regarding enemy mining actions. If political restrictions prevent overt interdiction, the knowledge of where mines are laid, the type and an approximate amount is essential. Localization of the mine threat greatly assists MIW forces.
- Establish the MIW Commander as a Primary Warfare Commander on Carrier and Expeditionary Strike Group Staffs.
- Formalize doctrine to reflect the changes in MIW and recognize the importance of countermine warfare. Eliminate the disparity between doctrine and practice.

Conclusion

> "*Future adversaries will strive to hold our deployments at risk by interdicting air and sea lines of communication, rendering debarkation points unusable, and delaying or denying political access. By projecting defensive power, Sea Shield will defeat these efforts and enable the U.S. Navy to 'climb into the ring' to conduct Sea Strike and Sea Basing in forward theaters of operation, setting the stage for combat victory*."[xl]

Sea Shield is the mechanism that "spreads the ring ropes" and enables the Joint Force to "climb into the ring" and conduct Sea Strike and Sea Basing. The extensive damage to USS *Princeton* and USS *Tripoli* in the Gulf War demonstrated the asymmetric threat presented by naval mines and the operational limits they can impose on the Joint Force Commander. Moreover, the Iraqi use of naval mines in the Gulf War of 1991 blocked U.S. forces from maneuvering in the Kuwaiti and Iraqi coastal waters and prevented the Joint Force Commander from utilizing the full capabilities of the assembled combat force. As Admiral Fallon observed from his position as Vice Chief of Naval Operations, "I don't care to be in a position where my options are constrained. If the United States Navy has an Achilles heel, it's mines."[xli] A strong MIW capability, an essential component of Sea Shield, allows the Joint Force Commander to overcome the limits imposed by naval mines and provides the "key to unlock the littorals."[xlii] With this capability, the Joint Force Commander gains the assured access and unfettered maneuver space needed to achieve the operational objectives.

The Gulf War revealed that the U.S. Navy, the world's most capable naval force, is vulnerable to an asymmetric MIW attack. In order to learn from the lessons of the Gulf War and overcome the shortfalls in future conflicts, the Navy needs to take some drastic steps. Improvements across the full spectrum of MIW to include both naval mining and countermine warfare are required in order to give Joint Force Commanders the capability to bring the full combat force to bear, maintain the initiative, and execute the operational

timeline. Investments in organic MCM systems should provide Carrier and Expeditionary Strike Groups the capability to conduct "in stride" attacks on enemy minefields.

However, these advancements alone will not overcome the ever-growing and ever-improving MIW threat. A culture change in the Navy that recognizes this threat and results in the mainstreaming of MIW through doctrine, training, education, and leadership needs to accompany the developing technology. In addition to elevating MIW to a core war fighting function with an established MIW Commander, creating MIW doctrine, establishing a base level of knowledge among the officer corps and incorporating realistic MIW Strike Group work-ups, the Navy must also ensure that MIW assignments are career enhancing and attract top performers across the spectrum of officer communities. A MIW force, capable of overcoming the vulnerabilities exposed by the Gulf War, requires the synergy of technological advancements and culture change.

Additionally, the technological advancements need to expand to include the breadth of the MIW continuum. The new organic systems are narrowly focused on only the fifth phase of CMW—Mine Countermeasures.[10] These systems should enable forward deployed Carrier and Expeditionary Strike Groups to conduct "in stride" MCM, but the other aspects of MIW such as offensive mining and phases 1 through 4 of countermine warfare continue to be neglected. While the organic systems provide an important capability, as long as these other MIW considerations are overlooked, Joint Forces will continue to be vulnerable to naval mines and the lessons from the Gulf War will have to be relearned.

In a less forgiving battle or in the hands of non-state actors, powerful naval mines have the potential to drastically shape the battlespace and limit a commander's options. Without

[10] Appendix B lists the Phases of CMW.

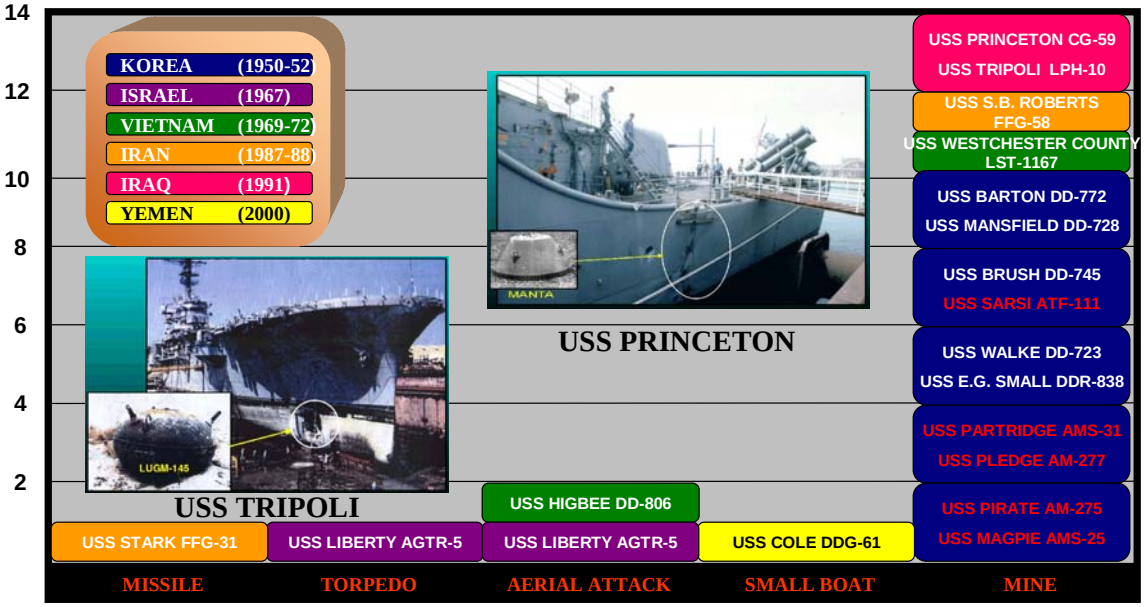
further investment in MIW capabilities and broad acceptance as a core war fighting function, MIW will prove to be the Navy's "Achilles Heel" in future conflicts.

APPENDIX A—U.S. SHIP CASUALTIES CHART

Information in this Appendix is drawn from *Naval Mine Warfare: Operational and Technical Challenges for Naval Forces.*[xliii]

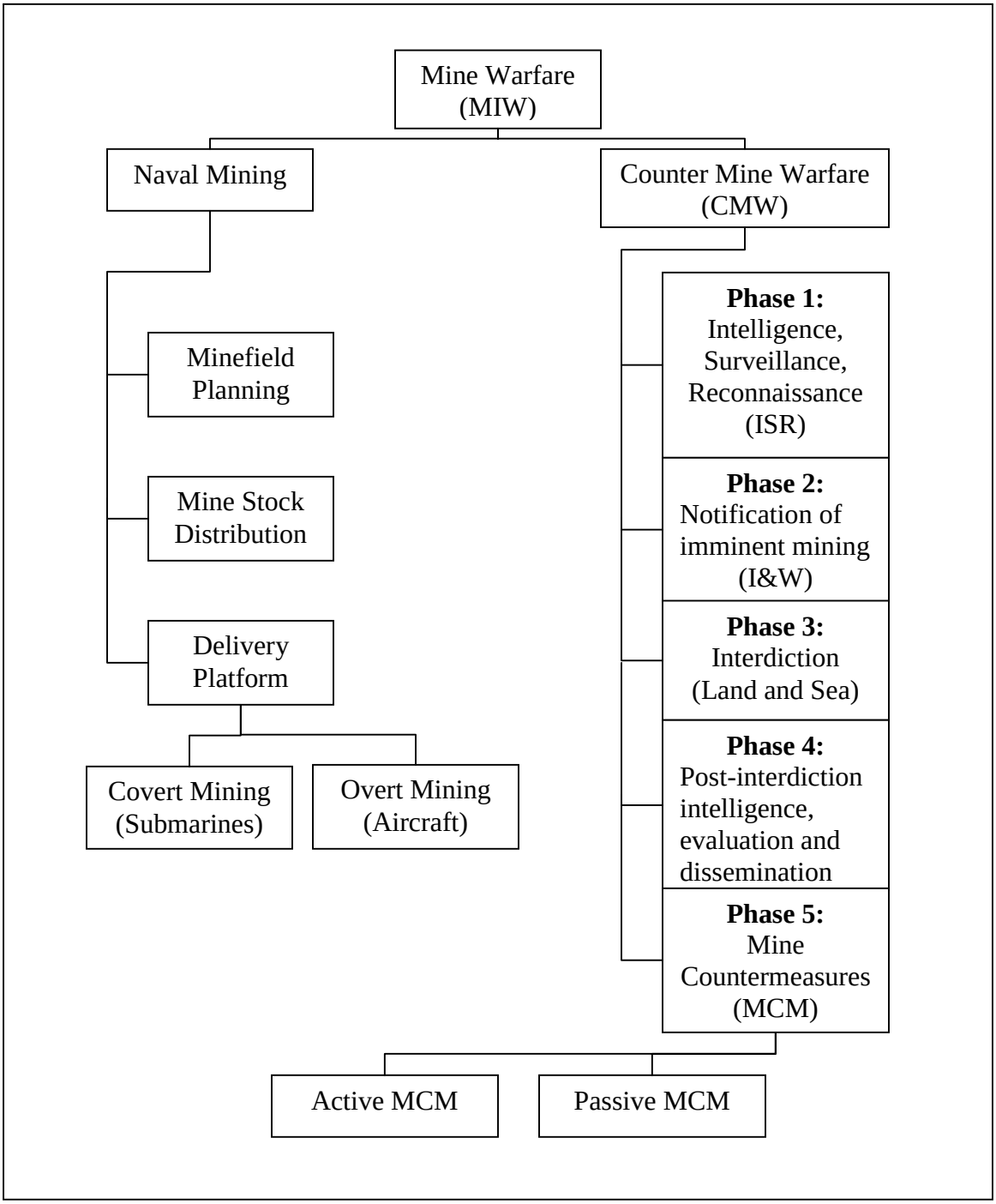
US Ship Casualties by Weapon Type

1950- Present



APPENDIX B—MIW COMPONENTS

Counter Mine Warfare information in this Appendix is drawn from *Naval Mine Warfare: Operational and Technical Challenges for Naval Forces*.[xliv]



APPENDIX C—ORGANIC MCM SYSTEMS

Information in this Appendix is drawn form the *U.S. Naval Mine Warfare Plan*[xlv] and Admiral Natter's *U.S. Naval Institute Proceedings* Article, "Access is not Assured."[xlvi]

Remote Minehunting System (RMS)
RMS is a high-endurance, remotely operated, surface-ship launched and recovered semi-submersible vehicle towing a mine reconnaissance sonar. The system will conduct rapid reconnaissance of bottom and moored mines from the deep-water region to the 30-foot contour of the Very Shallow Water region. Mine reconnaissance operations conducted by RMS will determine the presence of mine-like objects and safe routes or operating areas around potential minefields.

Long-Term Mine Reconnaissance System (LMRS)
LMRS will operate from and integrate with Los Angeles (SSN-688) class submarines. LMRS will detect, classify, and localize mine-like objects in anticipated operating areas. It is an autonomous unmanned, undersea vehicle (UUV), launched and recovered from submarines, which provides clandestine mine reconnaissance.

Airborne Mine Neutralization System (AMNS)
AMNS is an expendable, remotely-operated device that will be employed by the MH-53 and MH-60 helicopters to explosively neutralize proud (i.e. unburied) bottom, close-tethered moored, and volume sea mines that are impractical or unsafe to counter using existing minesweeping techniques. The system will have a day or night, shallow and deep-water capability. Prior to the neutralization mission, a minehunting sonar or electro-optic system will have accomplished mine detection, localization, and classification. The AMNS will be flown to the mine location where it will deploy its expendable neutralization device to reacquire and neutralize the mine.

Organic Airborne and Surface Influence Sweep (OASIS)
A combination magnetic/acoustic influence sweep helicopter (MH-60) towed system that incorporates the most recent magnetic and acoustic countermeasure technology in one towed body to achieve increased depth capability over current influence systems.

Airborne Laser Mine Detection System (ALMDS)
ALMDS is an electro-optics-based mine reconnaissance system that will direct and localize drifting/floating and shallow-water moored mines from the MH-60 helicopter platform.

Rapid Airborne Mine Clearance System (RAMICS)
RAMICS is a helicopter-borne weapon system that will fire 20mm projectiles from a modified Gatling gun controlled by a blue-green light detection and ranging (LIDAR) sensor. The heart of the system is a supercavitating 20mm projectile that is specially designed for traveling tactical distances in air and water and driving a chemical initiator through a casing into the mine. The LIDAR locates and targets the mine and provides aiming coordinates to the gun's fire-control system. Rounds are fired at the mine in bursts, resulting in neutralization. The system will be capable of attacking mines on or very near the surface.

AN/AQS-20X Advanced AMCM Sonar
A helicopter-towed minehunting sonar system containing an integrated Electro-Optic Identification (EOID) device. It will be compatible with the MH-60 helicopter and provide Carrier Strike Groups (CSG) and Expeditionary Strike Groups (ESG) an organic capability for rapid detection, classification, localization, and identification of bottom, close-tethered, and volume mines. This capability is designed to enable CSGs and ESGs to transit or avoid mined areas in choke points and littoral areas with a high degree of self-protection.

APPENDIX D—NAVAL OFFENSIVE MINING SYSTEMS

Information in this Appendix is drawn form the *U.S. Naval Mine Warfare Plan*[xlvii] and *Naval Mine Warfare: Operational and Technical Challenges for Naval Forces.*[xlviii]

Mine Mk 56

The Mk 56 was an aircraft-laid, 2000-pound, medium-depth moored mine specifically designed for use against high-speed, deep–operating submarines. *It was completely removed from the inventory in FY02.*

CAPTOR Mine Mk 60

An obsolescent, air-dropped, medium depth (150 to 600 ft) moored mine. The CAPTOR (enCAPsulated TORpedo) Mine Mk 60 is a 2000-pound mine that employs a Mk 46 homing torpedo. It was designed in the 1970s to specifically attack the high-speed, deep-operating submarines (primarily Soviet) of the day. It was the U.S. Navy's principal antisubmarine mine. At one time it could be laid by aircraft, submarine, or surface ship. It acoustically detected submarines while ignoring surface ships. *CAPTOR was scheduled for complete removal from the inventory in FY02, but a small number are being retained for an indefinite period.*

The Quickstrike Family

The Quickstrike family of aircraft-laid, shallow-water bottom mines is closely related to an earlier family of mines named Destructors. Quickstrike can use two variable-influence target detection devices to detect submarines and surface ships.

The Quickstrike Mk 62 and 63 are air-delivered bottom mines that use General Purpose Low Drag Bombs Mk 82 and Mk 83 (500 and 1,000 pounds, respectively) as the explosive payload. Because a specialized kit is used to convert bombs into mines, demand for magazine space on aircraft carriers is dramatically reduced. These mines use an older TDD, the Mk 57, or when available, the TDD Mk 71. *These mines are based on 1960's technology.*

The Quickstrike Mine Mk 65 is a thin-wall, 2000-pound air-delivered bottom mine. This Quickstrike variant entered production in 1983 and became operational in 1988. This mine uses either the TDD Mk 57, Mk 58, or, when available, the TDD Mk 71.

Submarine Launched Mobile Mine (SLMM) Mk 67

The SLMM is a shallow-water, bottom mine that detects submarines and surface ships. It is delivered by submarine and is considered a clandestine mine. It is a modified Mk 37 Torpedo with a thin-wall mine warhead. *By FY02 only a small quantity will remain in the Fleet inventory.*

Improved Submarine Launched Mobile Mine (ISLMM) Mk 76

ISLMM is based on converting existing Mk 48 torpedoes into mines. It features dual mine sections (warheads) to increase submarine mine-laying capacity and has improved compatibility with the SSN-688 submarine fire control systems. The ISLMM will have a multiple waypoint turn capability and greater range than the SLMM, significantly increasing

the number of minefields that can be planted by submarine. The ISLMM R&D program is scheduled to run from FY00-03, followed by procurement from FY03-05.

Target Detection Device (TDD) Mk 71
A TDD is the electronic fuse that observes changes in the environment in order to detect ship and submarines and decide whether the target is close enough to damage. The Mk 71 is a programmable device capable of responding to emerging threats—such as quiet diesel-electric submarines, mini-submarines, fast patrol boats, and air cushioned vehicles—through a software modification. It adds an enhanced pressure sensor and has the capability to respond to remote control signals.

Versatile Exercise Mine System
The VEM is a specially constructed, interactive mine training shape used to assess the effectiveness of MCM operations, provide realistic training for MCM forces, and assess platform vulnerability. The VEM contains multiple influence sensors and programmable electronics that are housed in a mine case that presents a realistic sonar profile. The VEM is a micro-processor based system that can be loaded with customized software to either emulate a specific type mine or to collect influence signatures. The VEM can record time-tagged sweep and platform characteristic signatures in addition to mine events. The VEM also contains a two-way acoustic modem providing the capability to transmit real-time events (i.e. mine fires) and receive/execute operational commands (i.e. change programs, turn on/off, recovery, data recovery). All recorded data can be downloaded from the VEM after recovery and utilized for a detailed analysis of platform signatures, vulnerability, and tactics.

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