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The Operational Effects of Mine Warfare

By

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

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

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The second part of the paper explores the Mine Countermeasures (MCM) concept of operations, the difficulties countering the mine problem with recommendations to minimize the operational effects and lastly, the future of mine warfare in the context of "Joint Vision 2010" and beyond. This paper shows that the operational commander can minimize the operational effects of mine warfare by preventing mining, maintaining surveillance, minimizing maneuver space requirements, requesting MCM forces early in crisis, using creative schemes of maneuver and exploiting the miner's resource and environmental limitations.

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Introduction

Naval mines pose an asymmetric threat to the ability of United States Naval Forces to accomplish operational objectives in support of theater Commander-in-Chiefs (CINCs) or Joint Task Force (JTF) Commanders.

Navy leaders often associate the use of mines with their tactical consequences (i.e. ships sinking) however, mines have significant operational level effects. The operational goal of mining is sea denial and all naval forces are vulnerable to this threat. The use of mines by an adversary will reduce naval freedom of action, operational maneuver, surprise and aid the enemy's ability to concentrate its forces.

The difficulty in coping with naval mines stems from the inherent uncertainty of mine warfare, the inadequate quantities of mine countermeasures (MCM) forces, the slowness of MCM operations and the vast quantities of water space required for modern carrier battle group (CVBG) and amphibious readiness group (ARG) operations in the littorals. Compounding the problem is the fact that mines are relatively cheap in comparison to other modern weapons. The low cost of mining makes it attractive to unsophisticated navies that do not desire confronting the United States Navy force on force. The U.S. Navy Mine Warfare Plan states, "In terms of cost-effectiveness and impact on the littoral environment, mines are the single most attractive weapon available to anyone intent on inhibiting the ability of U.S. Naval Forces to project power from the sea."[1]

If operational commanders do not adequately deal with the mine problem, the operational concept of power projection from the sea in the littorals is not achievable in a mine warfare environment without significant risk. The operational commander can significantly reduce the effects of mines at the operational level. In order for operational commanders to minimize the adverse effects of mine warfare, they must be aware of the

restraints placed on their operations in a mine warfare environment. They must compensate for the mine problem by making effective use of intelligence, by preventing mining, by employing other schemes of maneuver and by employing effective risk management.

Section 1: Are Mines Really a Threat to the Operational Commander?

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 our war plans. We've been plenty submarine-conscious and air-conscious. Now we are going to start getting mine-conscious—beginning last week.[2]

-- Admiral Sherman after amphibious assault at Wonsan, Korea

To answer the question, "Are mines really a threat to the operational commander?" this paper examines three principle relationships. The three relationships are:

1) Operational perspective of mine warfare history
2) Mine warfare and operational art
3) Mine warfare and the U.S. Navy/Marine Corps Service Vision.

The analysis of these relationships will demonstrate that mine warfare is a threat to the operational commander and that it is relevant to operations that they will likely perform.

Operational Perspective of Mine Warfare History

David Bushnell conceived mine warfare when he used a wooden keg filled with gunpowder against the British during the American Revolution in 1776. His concept was to attach the mine to the enemy ship using a submarine. The original concept was tactically oriented, to sink a British ship and it failed. In 1778, the Americans tried to conduct mine warfare again at the Battle of the Kegs on the Delaware River. The American mine warfare plan was to float wooden kegs full of gunpowder and contact firing mechanisms down the river towards the British ships in Philadelphia.[3] Again, this tactical employment of mine warfare failed. Although the early tactical attempts failed, this was the use of mines by a weaker navy to reduce the strength of a stronger navy without directly confronting it.

In the years after the American Revolution, Robert Fulton attempted to sell mine warfare first to the French and then to the British. He demonstrated the use of mines to the William Pitt in 1797. The demonstration impressed William Pitt. Lord St. Vincent (speaking for the Royal Navy) did not agree however. He stated, "Pitt is the greatest fool that ever existed, to encourage a mode of war which they who command the seas did not want, and which, if successful, would deprive them of it."[4] Although Lord St. Vincent hoped mine warfare would disappear, his quotation is key because it suggests that the mine warfare had a potential in sea denial, an operational level effect.

During the American Civil War, Rear Admiral David G. Farragut entered Mobile Bay after it had been mined by the Confederates and became immortalized by his quotation, "Damn the torpedoes [mines], full speed ahead." Although not as notable as Farragut's grand entrance into Mobile Bay, the Confederate Navy used mines extensively to deny use of inland waterways by the Union Navy. The Confederate Navy greatly improved mining capability by the development of mines that could be turned on or off from shore (remote controlled mine) and chemical contact fuses.[5] At the operational level of war, a weaker Confederate Navy used mines to deny the use of the seas (or inland waterways in this case) by the superior Union Navy.

The use of mines continued to gain prominence during the Russo-Japanese War in which the Russians and Japanese extensively used mines against each other with success. Operationally, the Russians successfully used mines to prevent an amphibious landing by the Japanese at Port Arthur.[6]

During both World Wars, mines played an important role in naval warfare. Mines were used successfully by Allied and opposition forces. Warring nations laid 205,000 mines during World War I and 226,000 during World War II. During World War I, the Allies

mined the North Sea extensively to restrict German access to the Atlantic Ocean. The Axis used mines to hinder the allied bombardment of Istanbul and the amphibious assault at Gallipoli. During World War II, the Germans mined several North American ports including the approaches to New York harbor, Chesapeake Bay, Wilmington and Charleston. The mining resulted in temporary port closures. During the World War II, the United States extensively mined the Japanese mainland in an effort to hinder the Japanese use of sea lines of communications (SLOCs).[7]

There has not been a decline in the use of mines in the post World War era. Mines were used in Korea, Vietnam and most recently by Iraq during the Gulf War. In fact, mine warfare has been an integral part of nearly all conflicts since the Civil War.

Throughout history, nations have used mines at the operational level to achieve sea denial. The operational level effects of sea denial have been prevention of amphibious landings, closure of SLOCs and disruption of naval operations. Consequently, sea denial reduces the flexibility the operational commander has to conduct operations.

The Mine Threat

APPENDIX A contains a brief narrative of the tactical mine threat the operational commander may face. This section focuses, however, on the operational aspects of the mine threat in today's littorals.

The defining feature of mines is that they are cheap in terms of money, knowledge, training and risk to the nation that uses them. Any nation in the world can buy mines if they desire. According to the U.S. Navy Naval Mine Warfare Plan, 49 countries possessed mining capability at the time of its publishing in 1996. Of these 49 countries at least 30 have demonstrated the capability to produce mines and 20 have attempted to export them.[8] Many

potential U.S. adversaries possess a mining capability including China, North Korea, Iraq, Iran and several Balkan countries.

If a nation desires to deny the use of the seas, they have several weapons from which to choose. The list includes but is not limited to a traditional navy, submarines and coastal defense missile systems such as silkworm missiles. Mines are obviously cheaper than these alternatives and mines are readily available on the open market whereas it may be more difficult to purchase other advanced technology.

Modern technology often requires operators to receive extensive training to ensure proper system usage. Minimal training is required to design and lay mine fields. Once the mines are in the water, there is no need for human operators. Mines are excellent weapons because they minimize human interaction and do not need rest, food, or supervision.

Risk to the nation that uses mines is minimal. Often, mining occurs before open hostilities, and there is a reluctance to use force to prevent mining. If a weaker navy confronts a stronger navy force on force, they run the risk of loosing what fleet they have. A weaker nation can use mines without risk to their fleet, particularly their capital ships.

Mine Warfare and Operational Art

> *"Present day amphibious assault forces cannot operate in mine areas without experiencing significant delay or loss."*[9]
>
> ***– Major General J. Edward Hanlon Jr.***

The factors of space, force and time are important to the concept of operational art. Sea denial will have a significant effect on the way the operational commander applies space, force and time. For example, if an enemy successfully accomplishes sea denial and it results in delaying an amphibious assault, the operational commander has lost use of that space for maneuver. Consequently, he must attack with other forces or wait additional time for mine

clearance completion so that the amphibious assault can occur. This can have significant impact if he does not have adequate ground forces in theater or does not have time to wait.

Another important concept of operational art is the principles of war. The principles apply to all levels of war, tactical, operational and strategic. Joint Pub 3-0 lists the principles of wars as follows:

1) Objective	4) Economy of Force	7) Security
2) Offensive	5) Maneuver	8) Surprise
3) Mass	6) Unity of Command	9) Simplicity[10]

Of the nine principles of war, the use of mines by an enemy will have the most effect on our ability to achieve maneuver, surprise, mass and security.

Maneuver - The enemy's use of mines will greatly effect maneuver. Joint Pub 3-0 states, "The purpose of maneuver is to place the enemy in a position of disadvantage though the flexible application of combat power."[11] The use of mines by an enemy will drastically reduce the ability of the U.S. to maintain sea control and freedom of action. Sea control (air, surface and subsurface) is required to achieve successful operational maneuver in the littoral environment. Operational maneuver is critical to successful joint operations.

The most recent example in which the U.S. lost sea control was the Gulf War. The Iraqis were able to prevent an allied amphibious assault because of the use of mines in defending the coast of Kuwait. Admiral William J. Crowe highlights this fact.

> The reason we did not mount an amphibious operation against Kuwait during the Gulf War was primarily the mine threat. It is true that our feinting and maneuvering off the coast caused the Iraqis problems, and the value of deception was, of course, emphasized in the postmortems. The fact is, however, that we would have liked to have had the option of mounting an amphibious assault, but the mine danger was too serious.[12]

In the case of Gulf War, Iraq was not able to capitalize on the U.S. MCM shortfall. Admiral Crowe points out that the feinting had a large influence over the Iraqis. If Iraq had realized

that the U.S. was feigning an amphibious assault they could have concentrated those divisions against the main allied thrust. While it is doubtful that the war would have ended differently, it could have greatly increased coalition casualties.

Surprise - Joint Pub 3-0 states that, "The purpose of surprise is to strike the enemy at a time or place or in a manner for which it is unprepared."[13] In the near term, the U.S. does not have the ability to conduct clandestine MCM operations. Dedicated MCM forces are big and slow. In the littoral regions, an enemy will be able to detect current (or near term) MCM forces conducting MCM operations. Surprise is not achievable if dedicated MCM forces prepare the battlespace in the littorals for an amphibious assault.

Mass - Joint Pub 3-0 states that, "The purpose of mass is to concentrate the effects of combat power at the place and time to achieve decisive results. To achieve mass is to synchronize appropriate joint force capabilities where they will have decisive effect in a short period of time.[14] The U.S. Navy and Marine Corps team contribution to mass is power projection from the sea. Power projection from the sea requires U.S. forces to achieve operational maneuver. As previous argued operational maneuver might be lost to mines. A joint operation may not achieve mass if the Navy and Marine Corps do not project power from the sea. In fact, the lack of a credible power projection force could allow enemies to achieve mass against the U.S.

The achievement of mass often requires synchronization of all forces. The use of mines can disrupt synchronization. An example of mines disrupting synchronization was the delayed amphibious assault at Wonson, Korea. By the time the Marines finally made it ashore, the U.S. Army had been there for several days. U.S. forces were fortunate at Wonson because mass and synchronization were not critical to the ultimate success of their mission.

Security - Joint Pub 3-0 states that, "The purpose of security is to never permit the

enemy to acquire unexpected advantage."[15] The use of mines by an enemy may allow them to acquire unexpected advantage. Surveillance and prevention are the only way to ensure security. Political considerations often prohibit the commander from preventing mining activity since mining often occurs before the outbreak of open hostilities but adequate surveillance will prevent the enemy from achieving surprise.

Mine warfare and the U.S. Navy/Marine Corps Vision

> *"The threat posed by mines, especially in the pursuit of our interests in the littorals, is one that must not be allowed either to inhibit or deter us from our ability to execute our nation's tasking."*[16]
>
> ***-- Admiral Jeremy M. Boorda and General C.C. Krulak***

With the decline the former Soviet Union, the U.S. found itself in the position of not having a peer competitor on the seas. Without a peer competitor, the main threat to U.S. interests shifted from the Soviet Union to regional conflicts, predominantly in the world's littorals. Consequently, the U.S. Navy and U.S. Marine Corps shifted its strategy from open-ocean operations to operations in the littorals. The new strategy was published in the Navy's service vision paper *...From the Sea, Preparing the Naval Service for the 21st Century* (1992) and the Marine Corps' *Operational Maneuver from the Sea* (1997).

...From the Sea - *...From the Sea* introduced a new direction for naval operations, the Naval Expeditionary Force. The naval expeditionary force mission is to maintain a forward presence and project power from the sea in the littorals. *...From the Sea* recognizes that it is difficult to conduct operations in the littorals. In fact it states, "Some littoral threats -- specifically mines, sea-skimming cruise missiles, and tactical ballistic missiles -- tax the capabilities of our current systems and force structure. Mastery of the littoral should not be presumed."[17]

...*From the Sea* identifies the traditional operational capabilities of the U.S. Navy as forward deployment, crisis response, strategic deterrence and sealift. In addition to the four traditional capabilities, ...*From the Sea* adds four key operational capabilities required for its success. The four key operational capabilities are:

1) Command, Control, and Surveillance
2) Battlespace Dominance
3) Power Projection
4) Force Sustainment[18]

Battlespace dominance, power projection and force sustainment rely on unencumbered use of the littorals. A robust mine warfare capability is required to maintain unencumbered use of the littorals. Consequently, mine warfare is critical to the successful operational execution of the ...*From the Sea* strategy.

...*From the Sea* states, "Battlespace dominance means that we can maintain access from the sea to permit the effective entry of equipment and resupply. This dominance implies that Naval Forces can bring to bear decisive power on and below the sea, on land, and in air."[19] Battlespace dominance is sea and air control of the littorals. The use of mines by an enemy can preclude our ability to achieve battlespace dominance.

...*From the Sea* states, "Power projection requires mobility, flexibility, and technology to mass strengths against weakness."[20] Mines affect mobility, flexibility and mass because mobility, flexibility and mass rely on use of the sea. The power projection capability described in ...*From the Sea* is very similar to the Joint Pub 3-0 definition of mass. Mass was previously discussed in the operational art section of this paper.

...*From the Sea* discusses force sustainment. It states that, "It [force sustainment] requires open sea lanes of communication so that passage of shipping is not impeded by an adversary."[21] Mines can deny the U.S. access to SLOCs. SLOC denial could have serious impact on the ability of the U.S. to sustain combat operations considering the paucity of

strategic airlift. Admiral Boorda wrote, "With 95% of all material to be sent to support future regional conflicts going by sea, the ability to close vital waterways comprises a threat of strategic dimensions.[22] Open SLOCs are clearly necessary for sustainment.

Operational Maneuver from the Sea – *Operational Maneuver from the Sea* (OMFTS) is a strategy supplemental to the *...From the Sea* series using the same operational concepts as *...From the Sea.* OMFTS also recognizes that challenges to our ability to conduct power projection operations in the littorals exist. OMFTS specifically mentions MCM capability as one of seven capabilities that need improvement in order to make the strategy viable in the future. It suggests, "We must develop and enhance our counter-mine/obstacle reconnaissance, mine marking and clearing capabilities, precision navigation, and in-stride breaching to support maneuver at sea, ashore, and during transition from sea to land."[23]

Section 2: How Does the Operational Commander Counter the Mine Threat?

"There is a solution. The mine problem is not 10 feet tall; rather it is 5 feet 7 inches standing on a fragile cardboard box. We deceive ourselves portraying the enemy as having unlimited resources and capable of executing their battle plans perfectly."[24]
-- General Charles E. Wilhelm

This part of the discussion will focus on how the operational commander counters the mine threat. It will discuss the mine countermeasures forces and their concept of operations, miner limitations, current difficulties in solving the mine problem and the future.

MCM Forces and Concept of Operations

"In the littoral, we are all mine warriors."[25]
-- Major General Edward J. Hanlon

The United States Mine Warfare plan contains a concept of operations that uses a four level approach (peace to conflict) to support projection of power from the sea in the littorals. *Figure 1* lists the four MCM levels with corresponding assets and products produced.[26]

Level	Assets	Products
Mapping, Survey and Intelligence Operations	National Sensors, Oceanographic Survey	Planning Folders, Digital Bottom Maps, Tactics
Surveillance	National Sensors, Joint Force Assets	Minelaying Indicators, Minefield Locations, Minelayer Surveillance
Organic MCM	Joint Force Assets, Surface Combatants	Assess Threat, Focus Dedicated MCM effort
Dedicated MCM	Surface MCM (MCM, MHC Class Ships), Airborne MCM (MH-53E Helicopters), Underwater MCM, VSW Det	Reduce the Risk of Mines to Acceptable Levels

Figure 1

The lowest level in the concept of operations is the use of mapping, survey and intelligence during peacetime. This process is relatively new. Upgrades in technology have allowed for digital bottom mapping of the ocean floor that will assist in reducing the time required to conduct dedicated MCM operations. The intelligence community strives to acquire and exploit foreign mines to gain information critical to countermeasure operations. Planners develop mine threat folders as part of the deliberate planning process. U.S. assets continuously perform mapping, survey and mine intelligence operations around the world during peacetime. Operational commanders must ensure that intelligence personnel maintain current mine warfare threat information and that mine warfare planning is included in all operation and concept plan development.

Surveillance is a critical requirement as crisis escalates. Traditionally, mine warfare related targets have been too far down in the priority list to receive surveillance by national, CINC or JTF assets during conflict escalation. For example, the U.S. allowed Iraq to lay 1200 mines off the coast of Kuwait. Lyons, Baker, Edlow and Perin state, "We knew they were mining the northern Persian Gulf, but we did not track the ships once they left port, so we did not know where most of the mines were being laid."[27] Surveillance is critical to the

concept of operations and operational commanders must be willing to use their surveillance assets to accomplish this task.

The next higher level is the use of organic MCM. Organic MCM is also a new concept. The objective of organic MCM is to give CVBG assets the ability to conduct limited MCM operations and self-protection against mines until dedicated MCM forces arrive. Currently, there are few developmental organic MCM systems available for the fleet and they seldom deploy in practice. Organic MCM is required because dedicated MCM forces do not routinely deploy with CVBG and ARG due to the limited number of MCM assets and the slow speed of advance of dedicated MCM assets. Forward-based, dedicated MCM assets are also limited. The MCM concept of operations relies heavily on the development of these systems in the future.

Once the enemy has placed mines in the water, dedicated MCM forces perform the task of reducing the risk of mines. This often occurs after hostilities have commenced. These forces (MCM triad) consist of Airborne Mine Countermeasures (AMCM) helicopters, Surface Mine Countermeasures (SMCM) ships, and Underwater Mine Countermeasures (UMCM) Explosive Ordnance Disposal (EOD) divers. Admiral J. M. Boorda stated, "The ships, helicopters, and divers of our Mine Countermeasures Force provide a "blue-water" capability that is arguably the best in the world today."[28]

Difficulties Countering the Mine Threat and Recommendations

The U.S. has a difficult time dealing with mines when used by an enemy to achieve sea denial. The operational level reasons for the difficulty are:

1) MCM operations are slow
2) MCM forces are not integrated with CVBG and ARG
3) Uncertainty of mine warfare
4) Littoral environment is challenging
5) MCM assets are limited

MCM operations are slow - Current and near-term MCM operations are slow. Again, this is not the fault of the MCM forces but rather a result of the technology they use in the performance of their mission and the difficult environment that the littorals present. MCM forces still use much of the same equipment used in the early 1970s. Even in cases where the systems are new, they are not revolutionary in concept.

To help reduce the effects of this problem, the operational commander needs to focus part of his peacetime intelligence gathering toward mine warfare. Continuous intelligence assessment needs to include at a minimum, the mine threat, mine storage facilities, mine laying platforms and mine warfare doctrine if applicable. Additionally, operational commanders must request assets to conduct survey operations during peacetime.

As conflict escalates, the operational commander's first priority is prevention of mining. As General Wilhelm states, "The best MCM is stockpile destruction. It requires far less time and effort to blow up a warehouse full of mines than to sweep them once they are laid."[29] The operational commander must obtain rules of engagement (ROE) necessary to prevent mining from occurring whenever possible. Unfortunately, political considerations will often preclude the use of force for prevention. If mining is permitted, intelligence assets must track when, where and how much mining has been conducted by the enemy. If stockpile destruction does not happen, the next best action is to go where the mines are not.

The last thing a commander can do to minimize the effect of mines is to minimize the amount of maneuver space required for operations. This may mean reducing the standard size carrier operating area, reducing the number of operating areas or changing the size/shape of amphibious assault geometry. The bottom line is that the operational commander must trade time for space.

These actions will assist in reducing the amount of time required to conduct dedicated MCM operations; it will not completely alleviate the problem once mining has occurred. Sound staff planning and intelligence during peacetime and crisis escalation can result in significant timesaving.

MCM forces are not integrated - MCM forces do not integrate and deploy with the cornerstones of the littoral navy, the CVBG and the ARG. MCM forces conduct training with the forces before the CVBG and ARG deploy but they do not deploy as part of the group because of a lack of assets and their inability to keep up with a CVBG or ARG. The operational commander must request MCM forces separately.

Once the commander makes a request, it takes an inordinate amount of time for an integrated MCM task group to arrive in the theater. AMCM and UMCM can arrive in theater relatively quickly via C-5 transport. SMCM transits to a theater at 10 knots or can be loaded onto transport ships and sea lifted but this also requires time. To help compensate for the problem there are two surface MCM assets and several EOD detachments forward deployed to the Persian Gulf and Japan. Currently, forward deployed assets are insufficient to conduct large scale MCM operations.

To help reduce the effects of the problem, the operational commander must request MCM assets as early as possible in conflict. Specifically, they should place an extremely high precedence on getting AMCM and UMCM in theater. They may have to adjust the time phased force deployment (TPFD) schedule to get these assets in theater most expeditiously.

Uncertainty of mine warfare – Mine warfare is inherently different from other warfare specialties of the naval service in terms of risk. The exact number of mines laid by the enemy is seldom known, even if the inventory is known. This differs from submarines or surface units. The operational commander knows how many submarines the enemy has, how

many are located and how many are un-located. Similar accountability for each mine is impossible. Risk is inherently difficult to assess in this situation. Risk is statistical and presented to operational commanders in terms of transit risk to the first transistor of a given area after MCM forces have conducted operations. Statistical algorithms to quantify risk for subsequent ships and ships that loiter in an area do not exist.

The operational commander must use risk management to guide further MCM operations once mines are in the water. Operational commander should employ MCM forces to exploit gaps in the minefield and determine minefield boundaries and densities, not to clear whole areas where possible. Once mines are laid, there will always be some risk.

The operational commander must develop creative schemes of maneuver that compensate for mining and the subsequent loss of maneuver space and exploit minefield gaps. An example of an alternate scheme of maneuver is to use long range insertion instead of traditional near shore seaborne amphibious assault. Other examples of alternate schemes of maneuver are feigning an amphibious assault (like the Gulf War) and developing schemes of maneuver that minimize time spent in potential minefields.

The operational commander will conduct sea control operations to gain sea supremacy or sea superiority. They set criteria for declaring achievement of sea supremacy or sea superiority. Mines should be included in this process like other warfare areas such as anti-submarine warfare or anti-air warfare.

Littoral environment is challenging - The littoral environment presents MCM forces with unique challenges not found in the open-ocean. These challenges include poor bottom conditions, poor sonar propagation, poor underwater visibility and salinity layers. These environmental factors are challenging, however, the miner has difficulties of their own.

Water depth, bottom gradient, ambient acoustic noise and current limit the miner. The enemy can not mine everywhere. The miner's limitations vary with their mine inventory. The operational commander must understand the limitations and plan to conduct operations in water that the miner can not lay mines in.

MCM assets are limited. The U.S. has limited MCM assets. There is a shortage of forward-deployed ships and organic MCM is behind in its development and implementation. To compensate for the MCM asset shortage, the operational commander must stress the limitation of the miner's resources.

Miners have limited resources also. General Wilhelm argues that, "Individual mines are cheap, but mining an entire littoral region is not."[30] Miners do not have an infinite numbers of mines or minelayers and may have limited ability to move mines from stockpiles to the minelayers. If the size of the littoral is large enough, the miner may not have resources to mine the whole littoral. This will force the miner to select the areas that he will mine. If this decision is made too soon, the wrong area may be mined and consequently have no impact on our scheme of maneuver. General Wilhelm points out that "Mines are fire- and forget- weapons. Once deployed they cannot be shifted to meet changing condition. If the enemy is tricked into laying his mines too early, or in the wrong place, he may not have reserves to maintain existing fields or sow new ones."[31]

The goal of the operational commander is to lure the miner into mining early (assuming prevention is prohibited) and in a location where it does not effect his scheme of maneuver. The operational commander can achieved his goal by employing operational deception (exert pressure in many locations) and by keeping intentions unknown to the enemy by sound operational security.

Future, JV 2010 and Beyond

> *"We have lost control of the seas to a nation without a Navy, using pre-World War I weapons laid by vessels that were utilized at the time of the birth of Christ."*[32]
> ***-- Admiral Allan E. Smith***

While the U.S. continues its trend to outmatch any opponent by technological superiority, it is still vulnerable to asymmetrical threats. Mine warfare will continue to be an excellent weapon of choice to an enemy that does not want to fight the United States force on force. The number of countries that have access to mines and choose to have mines in their inventories will continue to grow in the future. In the near term, the U.S. could still find itself in the situation described at the start of this section by Admiral Smith.

Joint Vision 2010 is the United States Armed Forces joint service vision that shapes the direction of the armed forces. It outlines four new operational concepts that our joint armed forces of the future must be able to do. The four new operational concepts are:

1) Dominant Maneuver
2) Precision Engagement
3) Full-Dimensional Protection
4) Focused Logistics[33]

Joint Vision 2010 operational concepts do not differ greatly from ...*From the Sea.* It does not introduce anything new in terms of mine warfare and its application to operational art. The ability to defeat your opponent by maneuver is the centerpiece of both strategies.

Technology will have a large impact on mine warfare if the U.S. is willing to devote adequate resources to mine warfare. In the long term, the U.S. will aim to develop MCM systems that will have the capability to perform in-stride MCM operations. These systems must be organic to the CVBG and ARG. Naval forces can not wait for the arrival of dedicated MCM forces and must conduct MCM operations in parallel with other efforts to maintain or seize sea control.

Technological advances in stealth, communications and miniaturization will allow MCM systems to operate clandestinely by CVBG and ARG assets.[34] The operational commander of the future will have the capability to conduct MCM operations in the preparations for an amphibious assault and still preserve surprise.

An interesting side effect of emerging technology will be the increased cost of mines. Better MCM systems will force the enemy to develop better mines. This escalation will effectively increase the cost of mines and perhaps make them cost prohibitive. If technology can force mines to become too expensive, then they will not be the cheap weapons of choice.

General Wilhelm summarized the future, "A combination of modest investment in advanced technology and innovative concepts based on realistic assessment of the mine problem can give us back the initiative."[35]

Conclusion

The operational commander can see that history has proven mines as an effective method of sea denial. The mine threat is cheap and many potential enemies of the U.S. possess mines and the ability to use them. The U.S Navy and Marine Corps strategy framed by their service vision statements commit the operational commander to fighting in the littorals where mines are a threat. Mines are a threat to the ability of operational commanders to accomplish their missions.

While it is true that there is a deficiency in the ability of the U.S. to cope with mine warfare, the problem does not have to be catastrophic. Until the U.S. fully solves the problem however, the operational commander must minimize the impact of mining activity and compensate for this weakness with strengths he currently has at his disposal.

Endnotes:

[1] Director Expeditionary Warfare, United States Naval Mine Warfare Plan (Washington D.C.: 1996), 3.

[2] Admiral Forrest Sherman, quoted in Tamara Melia, Damn the Torpedoes (Washington D.C.: Naval Historical Center, 1991), 79.

[3] Arnold S. Lott, Most Dangerous Seas (Annapolis: USNI 1959), 6-7.

[4] Ibid., 8.

[5] Ibid., 9-10.

[6] James F. Ball, The Effects of Sea Mining Upon Amphibious Warfare, (U.S. Army Command and General Staff College, Fort Leavenworth, KS, 1992), 15.

[7] Ibid., 16-22.

[8] Director Expeditionary Warfare, 1.

[9] MajGen. Edward Hanlon, quoted in L. Edgar Prina and Mary I. Nolan. "In the Littoral, We Are All Mine Warriors: Interview with Maj.Gen. Edward J. Hanlon Jr., Director of Expeditionary Warfare," Sea Power, May 1997, 26.

[10] Joint Chiefs of Staff, Doctrine for Joint Operations (Joint Pub 3-0) (Washington, D.C.: February 1, 1995), A1-A3.

[11] Ibid., A2.

[12] William J. Crowe, The Line of Fire (New York: Simon and Schuster 1993), 326-327.

[13] Joint Chiefs of Staff, A-2.

[14] Ibid., A-1.

[15] Ibid., A-2.

[16] Jeremy M. Boorda and C.C. Krulak quoted in Director Expeditionary Warfare, United States Naval Mine Warfare Plan (Washington D.C.: 1996), iv.

[17] O'Keefe, Kelso and Munday, ...From the Sea: Preparing the Naval Service for the 21st Century, (Washington D.C.: September 1992), 5.

[18] Ibid., 7.

[19] Ibid., 8.

[20] Ibid.

[21] Ibid,. 9.

[22] Jeremy M. Boorda, "Mine Countermeasures – An Integral Part of Our Strategy and Our Forces," Date Unk, <http://www.ncsc.navy.mil/CSS/Papers/cnopaper.htm>, 1.

[23] Headquarters Marine Corps, Operational Maneuver From the Sea, (Washington D.C.:1997), 13.

[24] Charles E. Wilhelm, "Forward...From the Sea: The Mine Warfare Implications," Marine Corps Gazette, July 1995, 23.

[25] MajGen. Edward Hanlon, quoted in L. Edgar Prina and Mary I. Nolan, 23.

[26] Director Expeditionary Warfare, 4-8.

[27] Lyons, Baker, Edlow, Perin, The Mine Threat: Show Stoppers or Speed Bumps?, (Alexandria, VA: Center for Naval Analyses, 1993), 6.

[28] Jeremy M. Boorda, "Mine Countermeasures – An Integral Part of Our Strategy and Our Forces," 2.

[29] Wilhelm, 25.

[30] Ibid.

[31] Ibid.

[32] Admiral Allen E. Smith quoted in Melia, 76.

[33] Joint Chiefs of Staff, Joint Vision 2010, (Washington: 1995), 20-26.

[34] Daniel A. Crute, "Naval Mine Warfare Vision 2010," Date Unk., <http://www.ncsc.navy.mil/CSS/Papers/vision.htm>, 3.

[35] Wilhelm, 23.

Appendix A: The Tactical Mine Threat

This appendix provides the reader with a tactical level discussion of the mine threat. The goal is to provide readers with no mine warfare experience a basic understanding of the types of mines that an operational commander might face.

Doctrine characterizes naval mines by three essential factors, (1) actuation method, (2) water column placement and (3) the water depth zones in which they are used.

Two principal methods cause mine actuation, direct contact of a ship to the mine, or the influence of a ship on the mine's logic. Influence mines sense the acoustic, magnetic, pressure or seismic signature of a ship passing over it. Once the mine senses certain thresholds, the mine explodes. Miners can use different combinations of influence to complicate matters. For example, the mine can be "turned on" by the incoming acoustic signature of a ship and actuated by the magnetic signature of a ship once the ship is over the mine.

Mines can be placed on the bottom of the sea floor (called bottom or ground mines) or moored to the ocean floor with a positively buoyant case full of explosives (moored mines). Miners set the desired case depth beneath the surface.

The mine threat varies depending on water depth zone of the ocean at a particular location. Figure A-1 on the following page presents the navy definitions of the water depth zones, the mine type found in those water depth zones and the typical targets of those mines.

As an example, during the Gulf War a moored contact mine damaged the U.S.S. *Tripoli* (LPH 10) and an acoustic-magnetic bottom influence mine damaged the U.S.S. *Princeton* (CG 59).

Name	Water Depth (ft)	Mine Type	Typical Target
Surf Zone	HWM*-10	MC, BI, TR	Personnel/Landing Craft
Very Shallow Water	10 - 40	MC, BI	Landing Craft/MCM Ships/Shallow Draft Vessels
Shallow Water	40 - 200	MC,BI,MI	Surface/Sub-surface Vessels
Deep Water	> 200	MC,MI, RVM	Surface/Sub-surface Vessels

*HMW: High Water Mark MC: Moored Contact BI: Bottom Influence
MI: Moored Influence TR: Tilt Rod (Bottom Contact) RVM: Rising Vertical Mine

Figure A-1

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