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**NAVAL MINES IN THE 21ST CENTURY: CAN NATO
NAVIES MEET THE CHALLENGE?**

by

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June 2005

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**NAVAL MINES IN THE 21ST CENTURY: CAN NATO NAVIES MEET THE
CHALLENGE?**

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

With the end of the Cold War, NATO countries have embarked on transformation initiatives within their militaries to address the new security realities of the 21st century. One of the realities that has not changed is the threat posed by sea mines. Global proliferation of sea mines, both older variants and advanced new designs, has continued to grow and presents a unique challenge to maritime security. NATO naval forces must be prepared to counter the danger posed by mines to shipping, both civilian and military, and to ensure that vital sea lines of communication (SLOCS), strategic chokepoints throughout the world, commercial ports and naval bases remain open and uncontested as they find themselves participating in more security operations at home and abroad.

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LIST OF ACRONYMS AND ABBREVIATIONS

Glossary	
ALISS	Advanced Lightweight Influence Sweep System
ALMDS	Airborne Laser Mine Detection System
AMCM	Airborne Mine Countermeasures
AMDS	Advanced Mine Detection System
AMNS	Airborne Mine Neutralization System
AUV	Autonomous Underwater Vehicle
C2	Command and Control
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CLZ	Craft Landing Zone
CNO	Chief of Naval Operations
COMINEWARCOM	Commander, Mine Warfare Command
EOD	Explosive Ordnance Disposal
EODMU	Explosive Ordnance Disposal Mobile Unit
GCCS-M	Global Command and control System - Maritime
GPS	Global Positioning System
HF	High Frequency
ISR	Intelligence, Surveillance, and Reconnaissance
JTF	Joint Task Force
LIDAR	Light Detection and Ranging
LMRS	Long-term Mine Reconnaissance System
LSM	Littoral Sea Mine
MCM	Mine Countermeasures
MCS	Mine Countermeasures Command, Control, and Support Ship
MEDAL	Mine Warfare Environmental Decision Aids Library
METOC	Meteorology and Oceanography
MHC	Minehunter, Coastal
MIO	Maritime Interdiction Operations
MIW	Mine Warfare
MIWC	Mine Warfare Commander
MMS	Marine Mammal System
MNS	Mine Neutralization System or Mission Need Statement
MWTC	Mine Warfare Training Center
NMRS	Near-term Mine Reconnaissance System
NRF	NATO Response Force
NSSN	New Attack Submarine (nuclear powered)
NSWC	Naval Surface Warfare Center
OASIS	Organic Airborne and Surface Influence Sweep
RAMICS	Rapid Airborne Mine Clearance System
R&D	Research and Development
RMS	Remote Minehunting System
ROV	Remotely-Operated Vehicle
SAHRV	Semi-Autonomous Hydrographic Reconnaissance Vehicle
SLOC	Sea Lines of Communication

SMCM	Surface Mine Countermeasures
SNMCMGR	Standing NATO Response Force Mine Countermeasures Group
SW	Shallow Water
SWIMS	Shallow Water Influence Minesweeping System
SZ	Surf Zone
TDD	Target Detection Device
UEP	Underwater Electric Potential
UHF	Ultra-High Frequency
UMCM	Underwater Mine Countermeasures
UUV	Unmanned Underwater Vehicle
VSW	Very Shallow Water

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I. INTRODUCTION

A. PURPOSE

With the end of the Cold War, NATO countries have embarked on transformation initiatives within their militaries to address the new security realities of the 21st century. One of the realities that has not changed is the threat posed by sea mines. Global proliferation of sea mines, both older variants and advanced new designs, has continued to grow and presents a unique challenge to maritime security. NATO naval forces must be prepared to counter the danger posed by mines to shipping, both civilian and military, and to ensure that vital sea lines of communication (SLOCS), strategic chokepoints throughout the world, commercial ports and naval bases remain open and uncontested as they find themselves participating in more security operations at home and abroad.

There are two main questions that this paper seeks to address. The first concerns the threat. With major advances in military technology and changes to doctrine, is there really a sea mine threat that could pose a significant challenge to today's navies? NATO naval forces are the most sophisticated and technologically advanced in the world. Yet the first Gulf War in 1991 taught us that even relatively inexpensive and unsophisticated sea mines can have catastrophic effects on our capital ships. The low cost, ease of use, and tactical effectiveness of sea mines make them a very potent threat, even to modern navies. Thus, to adequately answer the question of threat, I will consider the problem of proliferation, mine technologies and employment, and methods to counter the threat.

This leads to the second major question. Are NATO members adequately developing their MCM capability to meet the threat of sea mines? While it is true that NATO MCM forces are among the best, there are some notable shortfalls in capability development even as these countries push to develop new systems. This paper will analyze the new programs and initiatives that are shaping NATO's mine warfare community and discuss whether, and how, these programs are addressing the threat. This thesis argues that in an era where expeditionary warfare (and thus command of the littorals) is the central strategic requirement for naval forces, mine warfare must remain a

primary warfare discipline and must continue to be properly resourced and developed to face the mine challenge of the 21st century.

B. BACKGROUND

Mines are by no means a new threat. The destructive potential of the naval mine was first envisioned by the American inventor, David Bushnell, in 1776.¹ Bushnell developed the first known mine, or torpedo as it was called back then, by filling a wooden keg with powder and attaching a gunlock and hammer as the firing mechanism. It was designed to explode on contact, but proved to be dangerous and unreliable. Other inventors and scientists would continue Bushnell's work, developing more advanced and complex mines that would soon enter the inventories of every modern navy in the world.

While mines were not very effective against the British during the American Revolution, they were to play a much larger role during subsequent conflicts. During the Crimean War for example, the Russians, who had been suffering under an ever-tightening British and French blockade, relied heavily on both controlled and contact mines. During the siege of Kronstadt (located on the island of Kotlin near the Gulf of Finland) in 1855, the Russians were able to repulse a large invasion of French and British ships due in part to the deployment of mines in the harbor area coupled with new shore batteries. As a result, four Allied ships were damaged and the invasion was abandoned. The American Civil War saw greatly outmatched Confederate forces using mines extensively to inflict heavy casualties on Union ships. Naval mines were used extensively during the Russo-Japanese War of 1904-1905, particularly during the blockade of Port Arthur by the Japanese. During the blockade, the Japanese were able to augment their ships by laying a field of electro-mechanical mines on the nights of April 12th and 13th which would eventually claim the life of Admiral Makarov, Commander of the Russian Pacific Squadron.²

1 Minemen Volume 1. [Online] Available from: <http://www.tpub.com/mineman1/index.htm> Accessed 05 April 2005.

2 RUSSO-JAPANESE War. 11th edition, Encyclopedia Britannica, Vol. 23, pgs 919-930 [Online] Available from: <http://www.xenophongi.org/milhist/modern/russowar.htm> Accessed 07 April 2005.

As the twentieth century unfolded, naval mines became even more important to naval forces. While the British possessed one of the largest navies in the world, they had no qualms about using mines against Germany to enforce a blockade of the North Sea and to counter the increasing lethality of the German U-boats. World War I witnessed the largest use of mines as the United States and Great Britain deployed nearly 72,000 mines in what came to be called the North Sea Barrage.³ Although the effectiveness of the ‘barrage’ has been questioned, the use of mines as a strategic weapon was well on its way.

Improvements in mine design continued and by World War II, advanced influence ground mines that were air-deployable allowed greater flexibility in the use of offensive manning. The U.S. effectively reduced all imports into Japan by 97% between March and August 1945 during Operation Starvation in which it deployed nearly 12,000 mines in Japanese coastal waters.⁴ Korea, Vietnam, the Falklands Campaign, and the Gulf Wars among others, are conflicts in more recent times in which naval mines were used (with mixed results) to alter the course of events. The bottom line is that throughout history, mines have presented naval planners with a unique, stealthy, and deadly threat that if not respected has inflicted heavy casualties.

C. METHODOLOGY AND RESEARCH LITERATURE

This thesis research is based on primary and secondary sources. Primary sources include direct interviews with NATO mine warfare experts from the U.S. and European navies, as well as members of the intelligence community. Interviews were conducted in person, via phone conversation and through the use of e-mail correspondence. Additionally, NATO communiqués, the proceedings of relevant undersea warfare symposia, technical documentation and news sources were reviewed. Secondary sources include historical articles and commentary, journal articles, relevant books, and case

³ Thomas R. Bernitt and Sam J. Tangredi. *Mine Warfare and Globalization: Low-Tech Warfare in a High-Tech World*. in *Globalization and Maritime Power*. Edited by Sam J. Tangredi. (Washington: NDU press, 2002), pg 392.

⁴ Ibid.

studies. The case studies selected include a selection of conventional and irregular military operations in which belligerents utilized naval mine warfare to achieve their desired end state.

D. ORGANIZATION OF THESIS

1. Introduction

This chapter presents the historical background of mine warfare and provides the reader with an understanding of why and how sea mines have become such a dangerous threat to maritime interests. As NATO finds itself engaged in more operations of an expeditionary nature abroad, the ability to maneuver freely in the littorals, and thus the ability to effectively counter any potential mine threat is vital to its interests. Context will be provided by briefly discussing historical instances where mines were successfully used to inflict heavy damage and hinder maritime operations. Additionally, I will discuss the resources used for research and discuss how the remainder of the thesis will be organized.

2. The Threat

If modern navies, particularly western navies, are so technologically advanced, why do sea mines continue to pose such an intractable threat? In Chapter II, I will discuss the threat in terms of proliferation, mine technologies that NATO forces may have to defeat, and how these weapons are employed. Since the end of the Cold War and the collapse of the Soviet Union, large stockpiles of mines have found their way into the global arms markets and are filling the inventories of developing countries. Other major producers and exporters are doing their share to ensure that these countries have the latest technologies in their arsenals. In addition to these legal markets, the possibility of mines finding their way to non-state actors through black markets pose yet another problem. This chapter will conclude with an analysis of the geopolitical implications of proliferation for NATO forces to include closure of vital chokepoints, sea denial of the littorals, and the possibility of economic disruption caused by mining.

3. NATO MIW Capabilities

This chapter will discuss NATO's current mine warfare capability in terms of defense spending, force composition, and MIW assets. I will analyze how NATO countries are spending their defense dollars for mine warfare development. In the post Cold War age of transformation, military forces are changing into smaller, more professional forces. With this downsizing, it is expected that technology will make up for the reduction in numbers, thus quality is being emphasized over quantity. The question then is have NATO countries continued to invest enough defense dollars in mine warfare programs to defeat the mines being developed and exported by arms producers? Are the current research and development budgets enough to provide NATO's navies with the ships, aircraft and specialized systems that are necessary to not only keep up, but to effectively neutralize any potential threats? I will then look at the current force composition of NATO MCM forces; SNMCMGR1 and SNMCMGR2 including both dedicated and organic MCM assets and discuss new programs that are being developed. Finally, this chapter will look at other MCM assets that may be available for NATO use through its partners in the Partnership for Peace program and the Mediterranean Dialogue countries. These countries bring a wide array of experience and expertise to the MCM equation that could help NATO defeat the threat.

4. Case Studies

Chapter IV will take a more in-depth look at some specific case studies in which naval mines were used and that NATO and/or coalition forces comprised of some NATO members responded to conduct hunting and clearance operations. In this chapter I will look at The Tanker War between Iran and Iraq of 1987-1988, Operation Allied Harvest, Operation Desert Storm, and Operation Iraqi Freedom 2003. I will also review lessons learned from these conflicts and evaluate how the development of MCM technologies has changed as a result of the prior operations and how NATO mine warfare planners will leverage these technological changes in future conflicts. This chapter will then conclude with recommendations for current and future force structures based on the potential threat.

5. Conclusion

The final chapter will summarize my findings about the threat and how NATO will be able to respond now and in the future based on the level of commitment it has sustained in the development of its MCM capability. I will then make recommendations based on the findings.

II. THE THREAT

A. INTRODUCTION

The naval mine is a relatively cheap, easy to employ, highly effective weapon that affords weaker navies the ability to oppose larger, more technologically advanced adversaries. It is the ultimate fire and forget weapon, stealthily waiting for its victim (often for many years) to unwittingly cross its path. Mines also have tremendous psychological affects. Just the possibility that mines have been laid in a body of water is enough to bring maritime operations to a stand still, effectively denying or slowing access to a particular body of water or strategic chokepoint. Thus, a mine doesn't even have to blow anything up to have satisfied its mission. The delay caused by mining or the threat of mining could be enough to allow an adversary to achieve his desired goal. The mining of Wonsan Harbor in October of 1950 proved this as the delay caused by some 3,000 mines prevented over 50,000 Marines from coming ashore and allowed the North Koreans to withdraw their forces, avoiding a deadly pincer maneuver by the amphibious forces.⁵

Today's large capital ships are just as vulnerable to the threat of sea mines as previous generations of warships were. Despite technological advances designed to reduce ship's acoustic and magnetic signatures, mine technology has managed to stay ahead of the game. The most telling reminder of the effectiveness of mines is in the destruction wrought by these weapons on U.S. warships as recently as 1991 in Operation Desert Storm (USS Tripoli and USS Princeton) and a few years earlier during the Iran-Iraq War. On April 14, 1988, the U.S. frigate USS Samuel B. Roberts (FFG-58) struck a Soviet-designed World War I era contact mine. The blast damage broke the ship's keel and if not for extraordinary damage control effort of the crew, the ship would have sunk. As it was, the damage caused by this simple, antique contact mine was nearly 96

⁵ Gregory K. Hartmann and Scott C. Truver. *Weapons That Wait: Mine Warfare in the U.S. Navy*. Updated Edition. (Annapolis: Naval Institute Press, 1991), pg 231.

million dollars.⁶ Figure 1 represents a graphic indication of how mine target strengths have declined over the years as technology has improved. This presents a unique challenge to MCM forces.

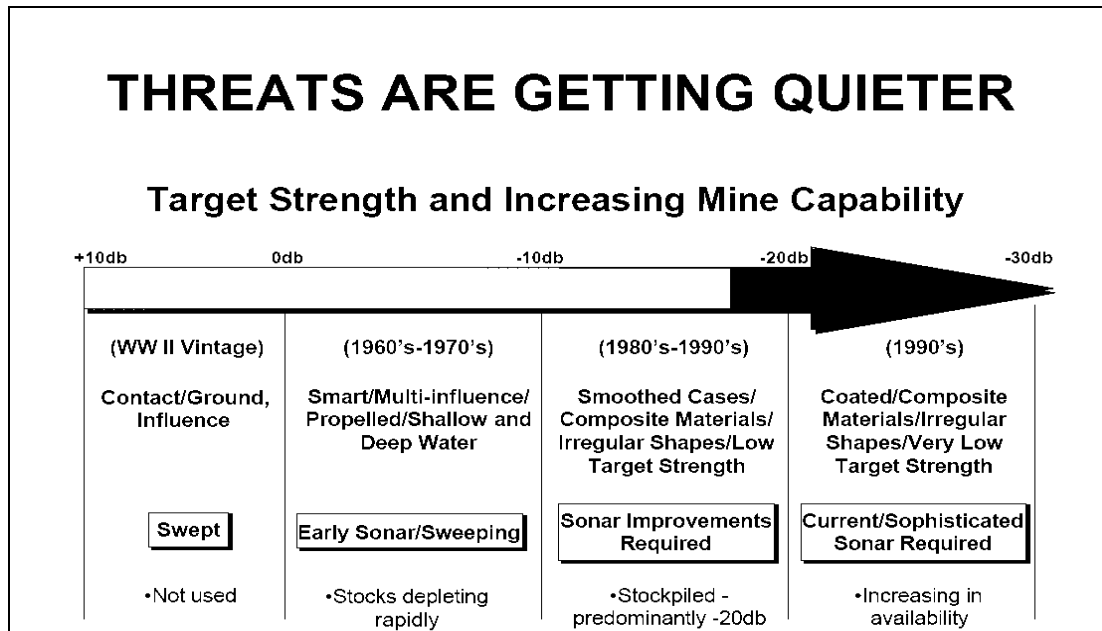


Figure 1. Target Strength and Increasing Mine Capability⁷

Today, the mine threat is still growing as many countries continue to procure and develop both older and more advanced mines. More than 50 countries currently possess mines, a 40% increase since 1986. Of these, at least 30 have demonstrated a mine-production capability, and 20 have attempted to export them.⁸ Among the leading exporters of mines are Russia, China, Italy (a NATO member) and Sweden. One of the most highly proliferated mines is the Italian-designed MN 103 Manta from SEI SpA. The Manta is a cone-shaped multi-influence ground mine with sensors covering acoustic,

⁶ Gregory K. Hartmann and Scott C. Truver. *Weapons That Wait: Mine Warfare in the U.S. Navy*. Updated Edition. (Annapolis: Naval Institute Press, 1991), 261.

⁷ CAPT T. M. Ahern, *Mine Warfare...A Core Navy Competency*. A brief presented by CAPT T.M. Ahern, PMS 407 in a Mine Warfare program brief, November 1999.

⁸ U.S. Naval Mine Warfare Plan. Fourth Ed, pg 2.

magnetic and seismic signatures. SEI SpA estimates that there are approximately 5,000 Mantas in inventories throughout the world.⁹ Some other mines that are highly prized are the Swedish GL-100 Rockans and the Intelligent Self-burying Mine (ISBHM) which by the nature of their design, are difficult to detect and counter. Stealth technology is being applied to mines to make them more difficult to detect. Among these developments are odd shapes that make burial more likely and hunting more difficult as well as specialized 'anechoic' or sonar-absorbing coatings, and non-metallic casings such as fiberglass that make sonars less effective. The use of odd shapes and specialized coatings on mines reduces the mines' target strength, i.e. the strength of return signature that sonars detect. Many of these stealthy mines are known to be in the inventories of developing countries.

The range of high-quality mines that are available on the global market are rapidly increasing. This development has been accelerated by the availability of former Soviet bloc expertise in mining technology and employment.¹⁰ The world arms market for conventional weapons is largely unregulated. While there are initiatives to halt the proliferation of weapons of mass destruction such as the U.S. sponsored Proliferation Security Initiative (PSI) which includes aggressive interdiction operations, naval mines are given very little consideration. Current arms transfer tables do not even specify naval mines among the inventory lists and there seems to be very little international agreement, even among Western nations, about which conventional weapons should have export controls applied.

In July 1996, 33 countries came together to form an institution to control the exports of various military or dual-use technologies.¹¹ This new institution approved the *Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use*

9 Nick Brown, What Lies Beneath. JANE'S NAVY INTERNATIONAL JUNE 2003. [Online] Available: http://www4.janes.com/K2/doc.jsp?t=A&K2DocKey=/content1/janesdata/mags/jni/history/jni2003/jni00730.htm@current&QueryText=%3CAND%3E%28%3COR%3E%28naval+%3CAND%3E+mines+%29%29&Prod_Name=JNI&. Accessed 11 April 2005.

10 Mine Warfare: The Key to Assured Access. Chief of Naval Operations Naval Expeditionary Warfare Division (N75). [Online] Available from: www.exwar.org Accessed 14 December 2004.

11 Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies. As approved July 1996 and amended December 2004. Fact Sheet provided by: Bureau of Nonproliferation, United States Department of State. [Online] Available from: <http://www.state.gov/t/np/rls/fs/30957.htm> Accessed 10 May 2005.

Goods and Technologies which basically provides a list of equipment and materiel that the signatory countries have agreed to maintain export controls on. In addition, these countries have agreed to submit semi-annual reports of their transfers to the other members within the organization.

Argentina	Australia	Austria
Belgium	Bulgaria	Canada
Czech Republic	Denmark	Finland
France	Germany	Greece
Hungary	Ireland	Italy
Japan	Luxembourg	Netherlands
New Zealand	Norway	Poland
Portugal	Republic of Korea	Romania
Russia	Slovakia	Spain
Sweden	Switzerland	Turkey
Ukraine	United Kingdom	United States

Figure 2. The 33 Wassenaar Arrangement Members.¹²

While this provides another venue for discussing the security implications of conventional transfers, it still does little to actually halt the transfers themselves since member countries can still decide what they will sell and to whom. It is worth noting that several member countries listed have technologically advanced export variants of naval mines. Further, while it is implied that naval mines are on the watch list under the generic reference of mines, there is no *specific* mention of naval mines.¹³ This lack of specificity is important because according to the State Department, there is no regime for monitoring or tracking naval mines like those that exist for landmines.¹⁴ Much of the debate stems from the inability to agree on classifying certain weapons as primarily offensive or defensive in nature.¹⁵ There is evidence that anxiety about this issue is

¹² Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies. As approved July 1996 and amended December 2004. Fact Sheet provided by: Bureau of Nonproliferation, United States Department of State. [Online] Available from: <http://www.state.gov/t/np/rls/fs/30957.htm> Accessed 10 May 2005.

¹³ Ibid.

¹⁴ Phone conversation with Mr. Chris Kessler of the State Department's Bureau of Nonproliferation Office of Export Controls and Conventional Weapons Nonproliferation. 10 May 2005.

¹⁵ Sabrina R. Edlow, Naval Mining and Arms Control. Center for Naval Analysis Report. April 1997.

growing. At the Fourth Meeting of Government Experts at the United Nations Review Conference on the Convention on Conventional Weapons (CCW) in January 1995, Sweden, an exporter of advanced naval mines, actually proposed banning them.¹⁶ It was noted during this meeting (which was convened more specifically to continue the debate on the landmine ban) that there is no international protocol restricting naval mines or including them in voluntary weapon-transfer reporting. Over a year later and at a different venue, naval mines were still not specified for arms control.

The proliferation of advanced mine technologies will continue, largely unregulated and untracked, for the foreseeable future. While it is very difficult to track the legal sale of mines to developing nations, it is next to impossible to track sales that occur on the black market. Due to their size and portability, mines can easily disappear from huge stockpiles that are poorly maintained and accounted for and make their way to the illegal markets. In addition to worrying about these weapons filling the stockpiles of potential rogue nations, NATO and other Western navies must be concerned about mines falling into the hands of non-state actors such as Al-Qaeda or other terrorist factions bent on violence.

B. MINE TYPES AND EMPLOYMENT

There are several different ways to classify mines, including how they are deployed, how they are situated in the water column, and how they are actuated. Mines can be air-launched from fixed or rotary wing aircraft, launched from any number of surface vessels including dedicated minelayers or more unconventional vessels such as fishing boats, tugboats, or rubber dinghies, or deployed more covertly from submarines. During the first Gulf War, Iraq utilized its Super Frelon helicopter as its principle mine laying asset.¹⁷ Once air superiority was established, they switched tactics to the release

¹⁶ Sabrina R. Edlow, Naval Mining and Arms Control. Center for Naval Analysis Report. April 1997.2.

¹⁷ Final Report to Congress on the Conduct of Hostilities in the Persian Gulf. Chapter VII, pg. 252. [Online] Available from: <http://www.ndu.edu/library/epubs/cpgw.pdf> Accessed 04 April 2005.

of drift mines from rubber zodiacs. During Iraqi Freedom when the United States and Great Britain owned the skies from the start, mine-laying was attempted with rubber zodiacs and modified surface crafts.

The three main classifications of mines based on their position in the water column are ground or bottom mines, moored or buoyant mines, and drifting or floating mines. Bottom mines lie on the sea bed and vary in shapes and sizes. Early designs were primarily cylindrical and these types still make up the majority of current inventories. While bottom mines, like all mines, can be a challenge to locate, the buried mine is exceedingly difficult requiring new technologies such as synthetic aperture sonars to penetrate the sediment layer that accumulates over it.

Moored or buoyant mines can further be classified as moored contact mines, moored influence mines, or moored influence target-seeking mines.¹⁸ Basically, all moored mines have an anchor and are attached with a tether that suspends them within the water column. These can either have long tethers for deep water operations or they can be close-tethered as an aid in counter-counter measures and for use in more shallow environments. Adjustable tethers allow moored mines to be deployed in varying depths of water.

Finally, drifting mines float freely on the surface and can be difficult to locate and identify due to varying amounts of marine growth on the casing, the sea state, or the visibility. During Operation Desert Storm, it was estimated that Iraqi forces intentionally deployed a significant number of drift mines to impede Coalition naval forces. One estimate is that approximately 20% of the floating mines that were recovered and destroyed were intentionally set adrift while the remaining mines had probably broken free from their moorings.¹⁹ Drifting mines also accounted for much of the damage experienced by merchant vessels during the mining of the Suez Canal and Red Sea (allegedly by Libya) in 1984 and during the Iran-Iraq Tanker Wars in the 1980's.

18 Thomas R. Bernitt and Sam J. Tangredi. *Mine Warfare and Globalization: Low-Tech Warfare in a High-Tech World*. in *Globalization and Maritime Power*. Edited by Sam J. Tangredi. (Washington: NDU press, 2002), pg 393.

19 Thomas R. Bernitt and Sam J. Tangredi. *Mine Warfare and Globalization: Low-Tech Warfare in a High-Tech World*. in *Globalization and Maritime Power*. Edited by Sam J. Tangredi. (Washington: NDU press, 2002), pg 393.

To better understand how and where mines are most effectively utilized, an understanding of depth regimes is necessary. The U.S. Naval Mine Warfare Plan divides the underwater battlespace into five depth zones. These are Deep Water (deeper than 300 feet), Shallow Water (40-300 feet), Very Shallow Water (10-40 feet), the Surf Zone (from the beach to 10 feet) and the Craft Landing Zone (the actual beach).²⁰

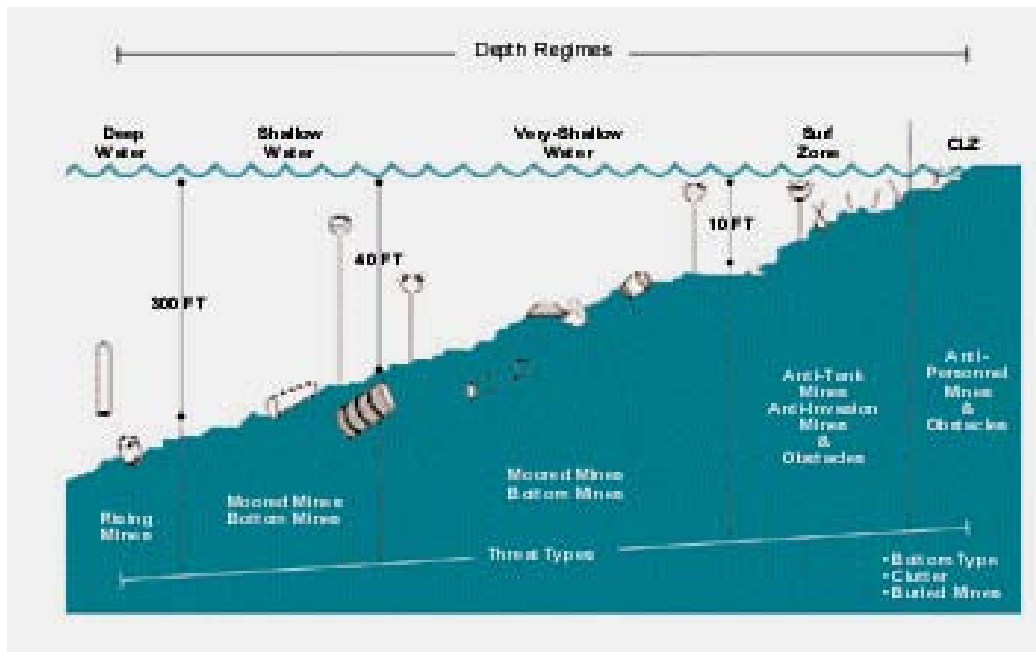


Figure 3. Depth regimes and the types of mines employed within them. 21

The VSW, SZ, and CLZ are the most difficult regimes to work in. During Operation Desert Storm, Coalition forces, with limited capability on hand, experimented with individual divers near shore but this was extremely dangerous and very limiting. During Operation Iraqi Freedom, VSW and SZ hunting and clearance, to include port clearance, was conducted with some success using a combination of UUVs, divers, and marine mammals. It should be noted that these operations were largely uncontested and in a relatively benign area.

²⁰ U.S. Naval Mine Warfare Plan. Fourth Ed, pg 89.

²¹ Ibid.

There are many advantages and disadvantages to the various types of available mines. Ground mines come in many shapes and sizes depending on their intended targets. Smaller ground mines are used from the Craft Landing Zone (CLZ) out to the Very Shallow Water (VSW) Zone where it is extremely difficult to exploit them based on today's technology limitations. Within the Surf Zone (SZ), these smaller mines are mainly designed for anti-landing/anti-tank utility. The more advanced mines, such as the Italian Manta, have unique shapes that allow for high rates of burial which in turn makes the mine harder to detect. These are generally used in the VSW to SW range. Additionally, because of the shallow environment, MCM forces are more exposed to an adversary's other potential defenses such as integrated coastal defenses. Ground mines have the advantage that they do not have to utilize a portion of their shell casing for flotation or buoyancy, thus they can contain larger explosive charges and they are also easier to deploy from air and subsurface platforms.

Moored or buoyant mines are able to be utilized throughout the various depths of the water column depending on the length of the tether. As noted above, a portion of the casing's space must be devoted to buoyancy, reducing the space for explosives. The advantage of moored mines is that they may be employed in both shallow and deep water which allows them to be used against a greater variety of targets. The major disadvantage is that they are easier to detect by today's advanced sonar systems since they do not enjoy the concealing properties of burial or other ground clutter. Because they are generally more bulky, they usually require a surface vessel for deployment. Another variant of the moored mine is the rising mine (also known as the moored influence target-seeking mine) which can be deployed in deep water against both surface and submarine contacts but was designed primarily as an anti-submarine weapon. This is an influence mine that will fire a homing torpedo at a target when the targeting parameters are satisfied. These are highly advanced weapons that were once only in the inventories of the Soviet Union and the United States. Now, they have entered the world market. Variants such as the Chinese EM-55 rising mine, which can be laid in waters as deep as 650 feet, are exported with little restriction or regard.²²

²² U.S. Naval Mine Warfare Plan. Fourth Ed, pg 35.

Finally, there is the standard drifting mine. Drifting mines are carried with the currents and can show up anywhere. While the use of drift mines is illegal under the venerable International Hague Convention of 1907 due to their indiscriminate targeting of vessels, the legality has not historically deterred their use. According to the convention, it is forbidden to lay drifting mines unless “they are constructed as to become harmless one hour at most after those who have laid them have lost control over them...”²³ Of course, the agreements of the convention are largely unenforceable and equally ignored by belligerents as seen throughout the World Wars and as evidenced by the indiscriminate use by Iran and Iraq in the eighties and nineties. Traditionally, drift mines are contact mines but that can no longer be assumed in the age of terrorism. As the current Iraq conflict has shown, remote-operated improvised explosive devices are highly effective weapons. Drift mines could certainly be likely candidates for this type of actuation if used in rivers, harbors or chokepoints as a terrorist’s weapon du jour.

Most variants of naval mines can be easily launched from nearly any type of platform. In Korea, the Wonsan mine fields were sewn by minelayers as well as a horde of sampans, while during the Persian Gulf War, dhows, tugboats, zodiacs and helicopters were used. Since mines can be launched by trawlers, speedboats, warships or aircraft, they are very versatile weapons. Their history of use by both state and non-state actors, from the complex minefields and drift mines in the Persian Gulf, to the random employment for terror/harassment in the Red Sea, has proven that mines remain a persistent and dangerous threat that NATO navies must be prepared to encounter and defeat. Along with understanding how and where mines are employed, NATO planners must understand how they are actuated in order to effectively exploit them.

C. METHODS OF ACTUATION

The most important classification standard for mines is the method of actuation. It is vital to understand the actuation method to not only know how to exploit the mine,

²³ Thomas R. Bernitt and Sam J. Tangredi, *Mine Warfare and Globalization: Low-Tech Warfare in a High-Tech World*. in *Globalization and Maritime Power*. Edited by Sam J. Tangredi. (Washington: NDU press, 2002).

but also to understand how *not* to actuate it. The three basic methods of actuation are contact, influence, and remote-actuated. Contact mines are normally moored or drifting and have either chemical horns or galvanic antennas that fire the mine when the horns or antenna come in contact with the hull of a ship. Contact mines are the oldest, simplest, and cheapest available to developing nations. As advanced technology permeates the arms markets, countries are also able to purchase modular Target Detection Devices (TDD) upgrade kits. These kits allow existing mines to be upgraded with new actuating devices. So, what may appear to be a standard contact chemical horn drift mine could now be a magnetic or acoustic influence mine with a ship counter or delayed-arming sensor installed. This type of technology presents a new level of danger and challenge for mine warfare specialists as they gather intelligence and train to counter the mine threat.

Unlike contact mines, influence mines are actuated when the weapon detects a specific influence parameter by a passing vessel. These can be magnetic, acoustic, seismic, pressure, underwater electric potential, remote-controlled, or a combination of any of the above. Multi-influence sensors make it much more difficult for countermeasures to be effectively employed against these mines and can be further complicated by the addition of ship counters and delayed-arming features. Mines are also increasingly being designed with counter-countermeasures features to defeat MCM forces.

Another concern for MCM planners is the proliferation of remote-actuated mines and their potential use in strategic chokepoints. Remote-actuated mines are basically like improvised explosive devices (IEDs) that may not be able to be countered with influence sweeps. The danger of remote-actuated mines lies in the fact that a third party could detonate the mines at will, particularly when MCM forces are in the process of exploiting the mines. These mines could be used as part of a networked, layered defense in places like the Strait of Hormuz, where mobile coastal batteries, employing advanced, fiber-optic guided anti-ship missiles might also be brought to bear against naval forces.²⁴ This

²⁴ Maj. Bruce I Gudmundsson, Covered by Fire: The New Face of Mine Warfare at Sea. Marine Corps Gazette. Mar 1999; 83,3. Military Module.

is a particularly dangerous scenario for European NATO MCM flotillas that strictly rely on SMCM and EOD to clear minefields. The ships are slow and have very poor defenses making them ideal targets for coordinated attacks with these advanced defense systems and anytime that there are divers in the water, they are highly susceptible to counter-fire.

If it seems unlikely that European MCM vessels would have to operate in that region based on recent political events, one only has to consider the fact that despite some European reluctance to be involved in the current conflict in Iraq, Persian Gulf oil resources are a vital interest to all NATO countries. The Gulf contains over 57% of the world's reserves.²⁵ The disruption of this type of resource could have severe global economic repercussions and as a result, NATO must be prepared to deal with any eventuality. This could realistically involve a scenario in which NATO MCM forces could have to conduct clearance operations in strategic Sea Lines of Communications (SLOC) such as the Strait of Hormuz.

D. MINING TACTICS AND COUNTERMEASURES

There are two categories of MCM operations that NATO planners have to be concerned about; offensive and defensive. Offensive MCM involves operations designed to prevent an adversary from actually putting mines in the water while Defensive MCM operations occur once mining has already been accomplished. For both categories, one of the key enablers for successful operations is intelligence. Intelligence, Surveillance and Reconnaissance (ISR) is vital to the conduct of all types of MCM operations. The ability to gather and disseminate accurate information about mines, tactics, training, and intent allows planners to formulate plans against an adversaries mining capability. Valid and persistent intelligence allows mine warfare specialists to more fully understand what type of threat they may be facing and how best to exploit the threat. It includes information about stockpile locations, mine-laying doctrine, and technical data on specific mines.

²⁵ Persian Gulf Oil and Gas Exports Fact Sheet. September 2004. [Online] Available from: <http://www.eia.doe.gov/emeu/cabs/pgulf.html> Accessed 10 April 2005.

As previously discussed, due to lack of arms transfer data, this becomes challenging and often requires assets such as human and signals intelligence as well as the use of satellite imagery. While some exporting nations, for example Italy, provide technical data on their export variants to allied countries to allow for the development of countermeasures, often, the only way to develop accurate information is to recover mines and reverse engineer them. In the near future, unmanned undersea vehicles will play an increasingly larger role in the development of persistent ISR.

Offensive MCM is the most desirable operation since it offers the greatest protection for maritime forces by destroying mines and mining capability before they can be used, yet the only way to actually ensure a high probability of preventing mining is to have actionable intelligence and then to preempt the deployment of mines, a course of action that is liable to present serious political difficulties for any state that does not wish to be labeled the aggressor. Nevertheless, given the stealthy nature of all naval mines, the only way to assure they do not go in the water is to destroy them where they are stored. Assuming the political risks are acceptable, the chief requirement for this approach is sound, *actionable* intelligence as to a belligerent's intentions and capabilities. In all cases, however, significant public and international skepticism has to be assumed. In Europe, a continent ravaged by wars throughout the past century, preemptive wars are particularly distasteful. This usually means that military action will only be tolerated when in response to other aggressions and in the case of mining, means that NATO will more than likely have to be prepared to execute Defensive, rather than Offensive, MCM.

Defensive MCM is what European NATO navies were primarily concerned with during the Cold War. Extensive mine countermeasure systems and platforms were developed and maintained by European navies concerned that the Soviet Union would use mines to close their harbors and naval bases. This is the primary reason that European NATO members have generally maintained a more robust surface MCM capability and also accounts for the mine warfare specialization that is practiced by most European navies. In contrast, the United States enjoyed a large protective buffer (the oceans) and thus focused more on a blue water navy able to meet any threats, including mining, well away from its home ports. Even now, while the United States invests in

MCM forces and systems designed to be able to conduct operations abroad, its European allies are still very much interested in their own coastlines. France's current mine warfare concept of operations assumes that the main role for its MCM forces will be to allow its fleet to break out of Brest, and Toulon, even though there is little likelihood that this will be required.²⁶ While France does not contribute MCM forces to NATO, it does cooperate with NATO's MCM forces and serves as a valuable ally in the region making its capabilities of vital interest to the NATO alliance.

The reality for NATO is that as it takes on more expeditionary operations, it is most likely to employ Defensive MCM to counter an adversary's mining tactics. Among these tactics are offensive and defensive mining. As previously stated, it is unlikely that NATO members will have to worry about an adversary conducting offensive mining operations against their home ports and harbors with the notable exception of non-state actors conducting terrorist operations. While this is certainly a valid threat that needs to be considered, it is more likely that NATO maritime forces will encounter mining in out of area operations. Therefore, we will look primarily at defensive mining tactics that NATO forces may face.

In defensive mining, nations utilize mines to protect their own littoral areas, ports and harbors. Mines can legally be employed in 'advertised' areas (as long as they are not in International waters). These types of operations are designed to dissuade and deter maritime operations in a given area. Another tactic is to covertly deploy various types of mines to attrite belligerent forces. During Operation Desert Storm, Iraqi naval forces created a mixed minefield along its littoral area and along the Kuwait coastline. It used a mix of bottom influence and moored contact mines. There is also evidence that approximately 20% of the mines it deployed were deliberately set adrift to disrupt Coalition naval forces.

²⁶ LT Arnuaud Lesquer, (French Navy MIW/EOD Officer). PEP Officer assigned to U.S. CMWC N-8. Interview conducted on 30 March 2005 at NAS Corpus Christi, TX.



Figure 4. Captured Iraqi tugboat/converted minelayer during Operation Iraqi Freedom

During Operation Iraqi Freedom, an Iraqi tugboat was intercepted carrying numerous contact and Iraqi-variant Manta mines. The vessel was configured to lay mines on a sort of conveyor belt and was disguised to look like it was carrying regular oil barrels.²⁷

Another form of defensive mining is the use of mines in strategic sea lines of communication (SLOC) to disrupt belligerent forces from exercising freedom of navigation and from reinforcing or supplying forces ashore. In the opening months of OIF, the U.S. Military Sealift Command sailed and chartered more than 210 ships and moved more than 94 percent of the nation's joint and combined capability to the fight via the sea.²⁸ In future conflicts, NATO operations will depend on sea control for logistics which makes protecting the SLOCs a vital concern for NATO forces. In the NATO Long-Term Scientific Study MO-2015, it was recognized that the most likely locations for NATO MCM forces to encounter a significant threat of mining was in the Baltic region and in the Persian Gulf Region.²⁹ While the Mediterranean Sea was mentioned, it was recognized that the major SLOCs are less-conducive to mining due to deep water although mines would still present challenges for amphibious operations.

²⁷ Operation Iraqi Freedom: A Timeline of Events. Center for Security Policy. [Online] Available from: <http://www.centerforsecuritypolicy.org/Iraqiminelaying.pps> Accessed 09 May 2005.

²⁸ Admiral Vern Clark, Chief of Naval Operations. Speech to the Senate Armed Services Committee on 12 February, 2004 entitled Credible Combat Power: Around the World...Around the Clock.

²⁹ NATO MO 2015 Long-Term MIW Study. Unclassified Executive Summary.

There are two primary types of Defensive MCM; Passive and Active. Passive MCM encompasses both localization and avoidance of mines, as well as the specific shipboard systems installed to minimize ship's signatures such as degaussing and the implementation of Quiet Ship regimes. Many ships are equipped with mine avoidance sonars such as the U.S. Navy's Kingfisher sonar which offer some mine detection capability for self-defense. Unfortunately, the acquisition range for many of these high-resolution sonars is relatively short. Organic systems under development such as the Remote Minehunting System (RMS) or the Sea Keeper will allow surface combatants greater standoff ranges when transiting suspected mined areas.

Finally, Active MCM is the use of specialized systems to locate, classify, identify and neutralize a mine or mines. Again, there are different methods for accomplishing active mine countermeasures. MCM forces utilize minehunting and minesweeping to satisfy clearance objectives. Depending on the objectives of the operations, different tactics are utilized. If the object is avoidance, minehunting is used to locate and identify mines. They are then classified and the contact information is stored for later possible clearance operations at a later time. Minehunters may also neutralize individual mines utilizing semi-submersible remote-operated vehicles or expendable mine neutralization vehicles such as the Sea Fox. When mines are discovered, the locations are then carefully plotted to allow naval forces to either transit safe routes through the field or avoid the area altogether. These operations will continue until the task force commander believes that he or she must continue with naval operations and the risk has been sufficiently mitigated through hunting efforts. Time and risk are key factors in the decision.

When a particular body of water is vital to operations and it is suspected of being mined, MCM forces must conduct neutralization operations utilizing either surface, sub-surface or air assets. The preferred method is mine sweeping. NATO forces, with the United States included, can conduct both mechanical and influence sweeping with its surface and air forces. Ships conduct mechanical sweeps by trailing sweep gear armed with explosive cutters, much like in World War II. They also can stream influence sweeps that simulate acoustic and magnetic signatures. AMCM assets conduct influence

sweeps in much the same manner, but are much faster and less vulnerable to the explosive affects of the mines. They are, however, just as vulnerable to shore defenses. In the sub-surface environment, neutralization is carried out by Explosive Ordnance Disposal (EOD) divers and Marine Mammals. Divers and mammals attach charges to mines and once clear, detonate them. In the VSW zones, unmanned undersea vehicles (UUV) are being developed to locate and neutralize contacts, including buried mines in lieu of divers or mammals. It is envisioned that these systems will eventually fully replace the human element in these areas.

E. GEOSTRATEGIC IMPLICATIONS OF PROLIFERATION FOR NATO

The proliferation of naval mines is of vital importance to NATO. As the NATO response force (NRF) concept matures, it is clear that NATO will continue to take a more active role in maintaining international security. Missions for the response force “might include deployment as a show of force and solidarity to deter aggression; deployment as a stand-alone force for Article 5 (collective defense) or non-Article 5 (crisis management, stabilization) operations; and deployment as an initial entry force for a larger force.”³⁰ The international security paradigm has changed since 9/11 and these types of interventions are going to become the rule rather than the exception. What these missions have in common is the underlying reality that they may be in far-off places around the globe. Naval forces will play a central role in these operations and as such, will potentially be exposed to the threat of naval mines.

As we have seen, naval mines are a weapon of choice for less powerful countries that wish to achieve sea denial or anti-access of maritime forces. Since these mines are becoming increasingly complex and lethal, the implications for a more expeditionary NATO are profound. NATO must continue to develop MCM capability sufficient to defeat the mine threat. The political will for the alliance is often shaky at best which makes it unlikely that it would survive the devastating affect of mass casualties to naval

³⁰ The NATO Response Force: At the centre of NATO transformation. NATO Homepage. [Online] Available from: <http://www.nato.int/issues/nrf/index.html>. Accessed 15 April 2005.

forces that mines could inflict. If operating in the dangerous littorals of developing countries or failed states is to be the mission of the NRF, NATO MCM had better be up to the task.

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III. NATO MCM CAPABILITIES

A. INTRODUCTION

Historically, European navies have tended to spend more on developing credible and effective mine countermeasure forces than the United States. This was as a matter of necessity based on their unique experiences in dealing with the mine threat, especially from WWI through the Cold War. During the Cold War, it was widely believed that the European ports and harbors would be mined by the Soviet Union in the event of a Soviet offensive. NATO countries that could not afford grand ocean-going navies could still afford mine countermeasures forces to protect their own littorals and so, there was a trade off. European NATO navies developed MCM forces, skills and doctrine that would allow them to defeat massive Soviet mining of their littorals and sortie their own naval forces while the U.S. was the blue water security guarantor, less concerned about its own coastal areas due to the geographical buffer presented by the oceans.³¹ While this division of labor was certainly practical during the Cold War, it would prove ineffective in years to come.

For the United States, the interest in mine warfare has historically followed a pattern of peaks and valleys. When there was a direct threat, there was a lot of interest. In interim years of peace and stability, mine warfare atrophied. In fact, it wasn't until the United States had to abort the major amphibious operation at Wonsan because of extensive mining and several casualties to minesweepers and destroyers, alike that the U.S. decided to get more serious about mine warfare³². Nearly forty years later, it was evident that this decision, which was long on rhetoric and short on funding, didn't seem to last long. In 1991, the U.S. once again found itself thwarted by mines. In February 1991, U.S. forces faced an Iraqi minefield off the Kuwaiti coast containing a combination of contact and influence mines. As a result, the potential cost of conducting an

31 Thomas R. Bernitt and Sam J. Tangredi, *Mine Warfare and Globalization: Low-Tech Warfare in a High-Tech World* excerpt from: *Globalization and Maritime Power*, Ed by Sam J. Tangredi. (NDU, 2002), Ch 20.

32 RADM Paul J. Ryan, and Truver, Scott C. *U.S. Navy Mine Warfare Vision...Programmes...Operations: Key to Sea Power in the 21st Century*. NAVAL FORCES, No 3.

amphibious landing under those conditions made it a much less attractive option. It also suffered major damage to two surface vessels, the USS Tripoli and the USS Princeton as they actuated both LUGM contact and the Iraqi variant of the Italian Manta mines.³³ It fell on primarily European MCM forces, which had maintained some semblance of mine warfare proficiency, to clear the mines that had been laid in the littorals of Kuwait and Southern Iraq. The problem was that the time lag for these extremely slow forces to transit to the Persian Gulf ensured that this effort would not be realized until well after the conclusion of the conflict. It was at this point that the United States truly decided to get in the MIW business having learned valuable lessons from its European allies.

As the Cold War has faded from memory, a new security paradigm has emerged in which some of the critical factors are global international terrorism, regional instability caused by failed or failing states, and humanitarian crises. This new paradigm is the context for the current push toward military transformation. As a result, defense dollars are being stretched in a number of ways to address the new threats, including massive costs for current operations. As fiscal constraints have continued to temper most defense spending, the security landscape has changed dramatically since September 11th requiring Western countries to rethink how their defense dollars are best utilized. Homeland defense has become a much higher priority for the United States and its allies as the reality has settled in that ocean barriers as a buffer against attack is no longer a guarantee and that transnational terrorism can strike anyone, anywhere. Even the United States, deeply committed in Iraq and Afghanistan, has reached a fiscal wall and is having to make painful tradeoffs between wants and needs despite a nearly 35% increase in defense spending since 2001.³⁴

Coalition countries, including NATO allies, are also involved in continuing operations in Iraq, Afghanistan, throughout the Mediterranean region under the auspices of Active Endeavor, and other contingencies from the Balkans and Africa to Southeast Asia. The monetary cost of these operations is staggering and is forcing countries to

33 RADM Paul J. Ryan, and Truver, Scott C. U.S. Navy Mine Warfare Vision...Programmes...Operations: Key to Sea Power in the 21st Century. NAVAL FORCES, No 3.Ibid.

34 Department of Defense Budget. Office of Management and Budget the Executive Office of the president. [online] Available: <http://www.whitehouse.gov/omb/budget/fy2005/defense.html> Accessed 11 February 2005.

scale back some of their programs, including programs in the area of Mine Warfare. The fiscal realities that are shaping the force have seen European NATO countries investing in traditional dedicated forces (often maintaining hulls well past their normal service life) with moderate upgrades to legacy platforms while the United States has shifted from a dedicated force mentality toward Organic MCM. The role of technology and transformation for both concepts continues to decrease the number of platforms, increase the use of Unmanned Undersea Vehicles (UUVs), and continues to reduce force size, which in the long term reduces personnel costs which consume a considerable amount of defense budgets.³⁵

While the new security realities of the 21st century define how limited defense budgets are spent, it is important that planners do not forget the lessons of the past and overlook or downplay the danger of naval mines to maritime forces. NATO MCM capability must remain a step ahead of the threat. NATO cannot afford to underestimate the disruptive capability of today's sea mines, both militarily and economically, and therefore must continue to develop forces and doctrines that can defeat today's naval mines and countries that would use these technologies. There are basically only three ways to deal with the threat of naval mines. These are preemption (that is stopping an adversary from deploying mines), punch-through or in-stride operations, or dedicated MCM operations in the inshore or offshore environment. These different operations require a vast array of capabilities. To that end, NATO has several resources that continue to focus on the threat to include their standing MCM forces, research institutions, and training facilities.

B. MINE WARFARE ORGANIZATIONS

NATO's standing mine warfare forces officially consist of two Standing NATO Response Force (NRF) Maritime Counter Measures Groups (SNMCMG1), formerly MCMFORNORTH, and (SNMCMG2), formerly MCMFORSOUTH. In addition, NATO relies on the United States Mine Warfare Command headquartered in Corpus

³⁵ R. Nicholas Burns, U.S. Ambassador to NATO. Press Conference conducted in Poiana Brasov, Romania. October 13, 2004. [online] Available: <http://www.state.gov/p/eur/rls/rm/38486.htm>. Accessed 01 February 2005.

Christi, Texas, which maintains dedicated staff, surface, air, and sub-surface mine countermeasures forces around the globe. Finally, NATO is building cooperative relationships with the Partnership for Peace and Mediterranean Dialogue countries who routinely participate in joint training and exercises.

SNMCMG1's primary role is NATO's Mine Countermeasures Immediate Reaction Force. Currently, the force is comprised of seven surface vessels including: HMS Shoreham (United Kingdom) M 112, FGS Herten (Germany) M 109, ORP Czajka (Poland) 624, HNoMS Vidar (Flagship, Norway) N 52, HNoMS Hinnøye (Norway) M 343, HNLMS Makkum (The Netherlands) M 857, and BNS Aster (Belgium) M 915.³⁶ The force conducts operations throughout the European coastal regions, interacting with Baltic and Mediterranean navies, alike. Since 1998 SNMCMG1 has also been operating in coastal waters of the United States, Canada and Iceland.³⁷ SNMCMG1 acts as an independent NATO MCM flotilla in the event of mine operations.

SNMCMG2, formerly MCMFORSOUTH, is primarily responsible for the Mediterranean region and is stationed in La Spezia, Italy. It was established as a NATO Immediate Reaction Force on 27 May 1999 in response to the Balkans crisis. Since its activation, in addition to conducting training activities, it has participated in NATO peace support operations including Operation Allied Harvest in which it was responsible for locating and neutralizing unexploded ordnance and any potential mines in the Adriatic Sea. It also supports operation Active Endeavour in NATO's maritime contribution to the Global War on Terrorism in which it conducts Intelligence, Surveillance and Reconnaissance operations (ISR). SNMCMG2 has participated in several NATO and non-NATO exercises (to include joint exercises with Partnership for Peace and Mediterranean Dialogue nations) and has visited numerous ports in the Mediterranean Sea and the Black Sea.³⁸ It also participated in Operation Allied Harvest and deployed its flotilla to the Northern approaches of the Suez Canal during the opening months of

³⁶ NATO Homepage [online] available: <http://www.manw.nato.int/manw/pages/update/mcmfn/StPetersburg.htm> Accessed 01 February 2005.

³⁷ Ibid.

³⁸ NATO Homepage. [Online] available: <http://www.nato.int/ims/news/2004/n040520e.htm> Accessed 23 January 2005.

Operation Iraqi Freedom to conduct Q-route surveys and deter mining. For political reasons, this was under the auspices of Operation Enduring Freedom which NATO supports. SNMCMG2 is composed of: ITS Bersagliere, Italy (Flagship), FGS Laboe, Germany, SPS Tambre, Spain, TCG Edremit, Turkey, and ITS Chioggia, minehunter, Italy.

When not required for specific NRF events, the NATO standing naval groups will be carrying out the same activities as they have been doing under their old names, i.e., conducting defense diplomacy port visits, keeping continuous NATO maritime presence and providing day-to-day verification of current naval procedures, tactics and effectiveness. There are currently no U.S. mine warfare ships or aircraft assigned with the standing NATO forces. While U.S. forces are not assigned to the forces on a rotational basis like their European peers, the United States' MIW capability provides another tool in NATO's mine warfare chest if and when needed.

The U.S. Mine Warfare Command force is composed of 14 MCMs, 12 MHCs, 2 squadrons of MH-14 Sea Dragons, 8 mobile EOD detachments and Navy Special Clearance Team (NSCT) One; a combination of Navy SEALs, USMC Force Recon, and EOD with the MMS and new UUV detachment. In addition, the United States is aggressively pursuing development of organic MCM systems to allow Battle group commanders an 'in-stride' passive and active MCM capability. These systems are surface, sub-surface (to include UUVs), and air. MCMDIV 31 is forward deployed to Bahrain and is composed of 4 surface vessels. MCMDIV11 is forward deployed to Sasebo, Japan and has two surface assets that regularly train with both the Japanese and South Korean navies.

NATO member countries have also established advanced Mine Warfare Training Centers in Europe and the United States. The premier MIW School in Europe, Eggermin, is a Belgium-Dutch training facility but is also used for training NATO forces and ensuring NATO maintains its MIW proficiency. Eggermin offers NATO members advanced training through the use of its Mine Warfare Gaming System and Mine Warfare Simulator. The U.S. Mine Warfare Training Center in Ingleside, Texas is the U.S. equivalent of Eggermin. In conjunction with Coastal Systems Station (CSS) in Panama

City, Florida, MWTC provides an array of training for U.S. and NATO MIW exchange students. Along with these schools, the U.S. Naval Undersea Warfare Center, CSS Panama City, and SACLANT Undersea Research Center in La Spezia, Italy provide valuable resources for NATO MCM forces.

C. DEDICATED MCM ASSETS

The cornerstone of effective mine countermeasures for NATO lies within the standing dedicated forces. As previously stated, NATO's dedicated forces have a long history of conducting real-world operations in mine countermeasures. These forces can be divided into subsets based on their platforms and systems capabilities and limitations, specific areas of expertise and primary operations. Among the dedicated forces are surface mine countermeasures forces (SMCM) in which European navies are developing improved capabilities such as advanced sonars, mine neutralization vehicles, and expanding the use of drones (unmanned hulls operated remotely by a mother ship.) Additionally there are airborne mine countermeasures forces (AMCM), subsurface forces including submarine employed systems, Explosive Ordnance Division (EOD) personnel, and a combination of more specialized teams that include special forces and unmanned underwater vehicles for Very Shallow Water (VSW) operations.

The surface forces vary in mission from coastal mine hunters to mine countermeasures platforms designed for deep water operations. Since NATO has the ability to draw on more than the standing MCM forces in the event of contingencies, it is important to look at the whole force structure of member nations to understand the MIW capability that NATO is able to employ. Table 1 illustrates current and projected SMCM capabilities for NATO countries.

Table 1. Current and Future Force Structures

PROJECTED CHANGES IN MCMV FORCE STRUCTURE BETWEEN 2004 and 2010-2015				
Navy		Current Force Strength		Planned/Projected force Strength
<u>Belgium</u>		7 (6) Flower Class Tripartite Mine Hunters and (1) Aggressive Class Ocean going Mine sweeper		7 Will upgrade minehunters with new equipment including command-and-control systems, minehunting sonar and mine identification and disposal systems between 2004 and 2009. (STN Atlas Seafox Mine Id and Disposal System (MIDS)
<u>Bulgaria</u>		20: (4) Sonya Coastal Minesweepers, (4) Vanya Coastal Minesweepers, (4) Yevgenya Inshore Minesweepers, (6) Olya Inshore Minesweepers, and (2) PO 2 (501) Class Inshore Minesweepers. (2) Survey ships		6
<u>Croatia</u>		0		1 Croatia began construction of an MPMB Inshore MHC but due to budgetary constraints, has not taken delivery (UNK if they will)
<u>Canada</u>		12 Kingston Class Minesweepers		12 Considering upgrades utilizing the Remote Minehunting System (RMS)
<u>Denmark</u>		4 MSF Mark I Class		4
<u>Estonia</u>		2 Lindau Class (German Type 331) MHC		3 Plan to upgrade w/Sea eagle ROV
<u>Finland</u>		13: (6) KUHA Class Inshore Minesweepers (Pluto ROV), (7) KIISKI Class Inshore Minesweepers		9
<u>France</u>		13: ERIDAN (Tripartite) Class MHCs- Capable of hunting and mechanical sweeping (utilize Bofors Double Eagle Mk 2 ROV)		13

<u>Germany</u>		22: (+18 Seehund Minesweeping drones): (12) Type 332 MHC, (5) Type 333 MHC, (5) Type 352 Coastal Minesweepers		22 (+18 Seehund Minesweeping drones with an additional 3 MSD minesweeping drones on order and due to be in service in 2010) MHCs utilize SeaFox ROV for Mine disposal
<u>Greece</u>		13: (3) Adjutant Class Sweepers/hunters, (2) Hunt Class Minehunters, (8) ALKYON Class Minesweepers,		10 Adjutant Class were built in 1954 and are not expected to remain in commission
<u>Hungary</u>		3: (NESTIN Class) River minesweepers		?3
<u>Italy</u>		12: LERICI/GAETA Class Minehunters/Sweepers		8 + ? Utilize Pluto Gigas ROV
<u>Latvia</u>		3: (1) Type 331 MHC, (2) KONDOR II Class Minesweepers		?2
<u>Lithuania</u>		2: Type 331 MHC		?2
<u>Netherlands</u>		12: ALKMAAR Class with an additional (3) drones being constructed		8 (+3 drones) Will upgrade minehunters with new equipment including command-and-control systems, minehunting sonar and mine identification and disposal systems between 2003 and 2009. (STN Atlas Seafox Mine Id and Disposal System (MIDS))
<u>Norway</u>		8: OKSOY Class Minehunters/Sweepers		8 Hugin AUV trials are expected to be completed in 2005
<u>Poland</u>		22: (3) KROGULEC Class MHC, (13) GOPLO Class Minesweepers/Hunters, (4) MAMRY Class Minesweepers, (2) LENIWKA Class Minesweepers		?34 (14) KORMORAN Class MHC ordered with first two set to enter service in 2006
<u>Romania</u>		34: (3) M 40 Class Minesweepers (Commissioned in the mid 1950's), (2) CORSAR Class MCM Support Ships, (25) VD 141 Class Riverine Minesweepers, (4) MUSCA Class Coastal Minesweepers		?31
<u>Spain</u>		9: (6) SEGURA Class MHC, (3) MSC 268 Class Coastal Minesweepers		8 (2) Additional SEGURA Class have been ordered and the 268 Class were commissioned in the 1950's.

<u>Sweden</u>		21+ 5 drones: (7) LANDSORT Class Minehunters, (4) STYRSO Class Inshore Minesweepers, (1) GASSTEN Class Inshore Minesweeper, (5) M15 Class Inshore Minesweepers, (4) EJDERN Class Sonobuoy Craft, (1) MSF MK1 Drone, (5) SAM Class drone MCMVs.		21
<u>Turkey</u>		32: (5) EDINCIK Class MHC, (6) VEGESACK Class MSC(Minesweeper Coastal), (9) Adjutant Class MSC, (4) Inshore Minesweepers, (8) Minehunting tenders		26 (6) AYDIN Class Minehunter/Sweepers Coastal being built and will all be delivered in 2007. (4) Cove Class Commissioned in 1968 and the (8) MH Tenders were launched in 1942.
<u>UK</u>		22: (11) Hunt Class Minehunter/Sweepers, (11) SANDOWN Class MHC-all 22 employ an ROV (RCMDS)		?15
<u>USA</u>		27: (14) Avenger Class MCM, (12) Osprey Class MHC (1) MCM C2 Platform on lease HSV Swift		*10 First LCS is being built commencing 2005 with subsequent LCS assuming MIW role. Disposition of MCM/MHC platforms remains to be seen
TOTAL		372		299

Note: Data in Table 1 represents recent research conducted by Jane's Underwater Systems.³⁹

The realities of ever-changing defense budgets, military transformation, resource prioritization based on world-events and political realities, and the speed of developing and fielding new systems and technologies could certainly impact the projected forecasts. For example, many of Bulgaria's current SMCM vessels are poorly maintained, funded,

³⁹ Jane's Underwater Warfare Systems. [Online] available: [http://www4.janes.com/K2/doc.jsp?t=A&K2DocKey=/content1/janesdata/yb/juws/juws0001.htm@current&QueryText=%3CAND%3E%28%3COR%3E%28naval+%3CAND%3E+mines+%29%29&Prod_Name=JUWS&Accessed 28 January 2005](http://www4.janes.com/K2/doc.jsp?t=A&K2DocKey=/content1/janesdata/yb/juws/juws0001.htm@current&QueryText=%3CAND%3E%28%3COR%3E%28naval+%3CAND%3E+mines+%29%29&Prod_Name=JUWS&Accessed%2028%20January%202005).

and are being decommissioned as they realign their military.⁴⁰ Another example is the United States' pursuit of the Littoral Combat Ship. This platform is being designed (in one configuration) to fulfill the SMCM function. Since it is envisioned to provide modular capabilities that can be configured as a Battle Group Commander needs, it is difficult to put a hard number on potential forces for MCM.

AMCM capability is not as robust among NATO countries. In fact, the United States is currently the only NATO member country to employ aviation assets in a mine warfare capacity and it appears that none of the other NATO countries are interested in developing this capability.⁴¹ Currently, the U.S. has two active AMCM squadrons consisting of 10 MH-53E Sea Dragon helicopters per squadron. Of these, 8 are available per squadron for rapid deployment. These are HM-14 stationed in Norfolk, VA, and HM 15 stationed at NAS Corpus Christi, TX. These helicopters can conduct the full range of MCM activities including influence and mechanical sweeps and minehunting from deep water through the very shallow water zone. The MH-53E helicopters serve as the U.S. MCM rapid deployment force and train extensively with NATO during joint operations offering NATO AMCM capability. HM squadrons maintain detachments on 72 hour alert able to deploy via airlift to anywhere in the world. These assets, with a command and control staff and EOD detachments can be operational in theater within 10 days.⁴²

Subsurface MCM capability comes from a mixture of sensors and systems to include submarines equipped with enhanced mine detection and avoidance sonar suites, surface and subsurface launched Unmanned Undersea Vehicles (UUV) such as the Remote Environmental Monitoring Unit System (REMUS) UUV used quite effectively in Operation Iraqi Freedom and the Near-term Mine Reconnaissance System (NMRS),

40 According to Jane's Underwater Warfare Systems Analysis, MCMVs tend to be kept in service for very much longer than any other type of platform. As long as their hulls are maintained in a seaworthy condition (both wood, composite and GRP) it seems as if they can go on almost forever. For instance a number of navies are still operating MCMVs that were initially commissioned in the mid-1950s. However, it has to be assumed that many of these will no longer be operational, or even capable of being maintained in another 5 to 10 years time and must therefore be considered as having been removed from service for the purposes of the above table, and at present there do not appear to be any plans to replace them. Therefore, the projected strength given is quite speculative for some nations and will depend on the degree to which they are either prepared to keep obsolete vessels in commission, or replace them.

41 Information based on a phone conversation with LCDR Sara Santoski, USN. Currently serving as N802 at U.S. CMWC, Corpus Christi, TX. 10 February 2005.

42 U.S. Naval Mine Warfare Plan. Fourth Ed, pg 6.

NATO Explosive Ordnance Disposal (EOD) divers, Very Shallow Water (VSW) detachments, and the U.S. Navy Special Clearance Team 1 which consists of special forces divers and the U.S. Navy's Marine Mammal System (MMS). Subsurface systems are becoming more fully developed and as stated, their use was validated in part during actual clearance operations in Iraqi Freedom where over 500 underwater contacts were prosecuted and 90 were identified as mines or mine-like and destroyed.⁴³ The leading NATO navies are steadily improving their UUV capabilities.

D. ORGANIC MCM

Expeditionary and fast-paced maneuver warfare emphasizing speed and maneuver requires rapid time lines and execution to achieve its objectives. Advanced naval mines that may include complex layered defensive networks such as remote actuation coupled with sophisticated shore-based anti-ship cruise missiles and coastal batteries, present a unique challenge to these operations. Due to the slow and dangerous nature of mine countermeasures operations coupled with the understanding that unimpeded access to these increasingly complex littoral environments will be crucial for operational success, the U. S. Navy, in its new Global Concept of Operations entitled Sea Power 21, has spear-headed a doctrinal shift away from strictly dedicated MCM forces toward an in-stride capability for Battle Group commanders.⁴⁴

Dubbed 'Organic MCM', the goal is for Expeditionary and Battle Group commanders to be able to conduct in-stride intelligence, surveillance and reconnaissance, and subsequently to either avoid mined areas or punch-through these obstacles to achieve mission success. European NATO nations have also recognized the need for enhanced organic MCM capabilities through the development of UUV/USV/UAV technologies and systems.⁴⁵ There are several systems currently in development to provide this capability

⁴³ Ryan and Truver, 32.

⁴⁴Adm. Vern Clark, Chief of Naval Operations. Sea Power 21: Projecting Decisive Joint Capabilities. Proceedings. Oct, 2002.

⁴⁵ SACLANTCEN. Unmanned Underwater Vehicles for Covert Mine Hunting, Reconnaissance and Disposal. NATO Concept Development and Experiment White Paper. [online] Available: <http://www.act.nato.int/organization/transformation/cde/projects/cde.htm> Accessed 11 February 2005.

for both U.S. and other NATO naval forces. On the surface side, the Littoral Combat Ship (LCS) is being designed to carry modular mine warfare systems including future AMCM assets (in addition to other warfare configurations).

LCS will operate out ahead of or in conjunction with the battle group. It will carry UUVs, USVs, and have the facilities to support VSW and MMS detachments. It will also embark MH-60S helicopters which are due to replace the current MH-53E squadrons. These in turn will utilize advanced systems such as the Airborne Mine Neutralization System (AMNS) which is an airborne variant of the Atlas Elektronik Sea Fox mine destructor, AQS-20X Advanced AMCM Sonar, Organic Airborne and Surface Influence Sweep (OASIS), Airborne Laser Mine Detection System (ALMDS) for detection of shallow-water moored and drifting mines, and the Rapid Airborne Mine Clearance System (RAMCIS) which is a 20 mm Gatlin gun that is controlled by the ALMDS.⁴⁶

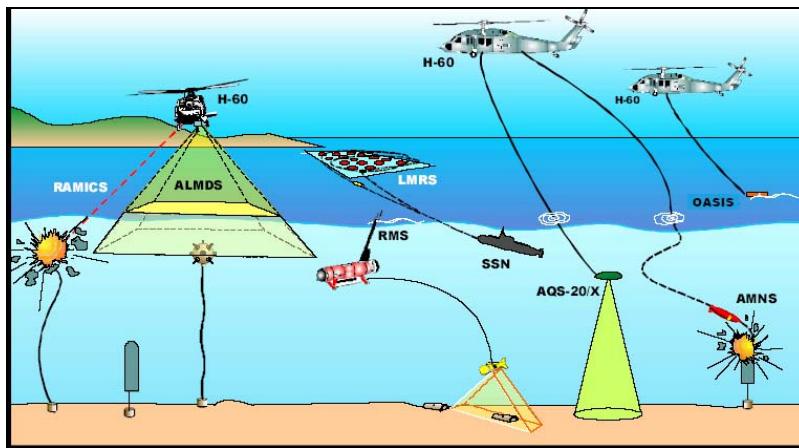


Figure 5. Organic MCM Concept Graphic⁴⁷

Other systems coming into service with NATO navies that offer robust capability are the U.S. Navy's AN/WLD-1 (V) 1 Remote Minehunting System (RMS) which can be deployed from surface combatants to move ahead of the battle group and deploy its own

⁴⁶ U.S. Naval Mine Warfare Plan, Appendix C.

⁴⁷ CDR John Brown, Brief for COMINWARCOM concerning the Organic Mine Warfare Concept.

tethered remote sonar, the AN/AQS 20, the Royal Norwegian Navy's HUGIN Mine Reconnaissance System (MRS), and the Battlespace Preparation Autonomous Underwater Vehicle (BPAUV).⁴⁸ The U.S. Navy is also looking at another semi-submersible system, *Sea Keeper* that was developed by the French defense firm, DCN. *Sea Keeper* is basically a lighter, improved version of Lockheed Martin's Remote Minehunting System. It will be tested by the U.S. Navy to determine its value for both shipboard and homeland defense missions.

E. CONCLUSION

The first decade of the 21st century promises many new challenges for NATO's naval forces. While the large-scale threat of European and U.S. coastal waters being mined by a major adversary is highly unlikely, there is a serious chance of advanced naval mines being used in regional areas of interest to contest control of the littorals. Naval mines also possess considerable potential as terrorist weapons. Therefore, it is vital that NATO nations continue to push advanced programs past the initial concept phase and develop, fund, and field the systems necessary to counter the threat in the difficult VSW and Shallow water zones.

While European NATO nations are quite adept at SMCM, they need to develop an AMCM capability. There are already systems being developed that *could* yield this capability such as Spain's SH-60B upgrades, however, as NATO navies find themselves involved in more out of area operations, this capability must become a higher priority.⁴⁹ Geopolitical realities that have emerged since 9/11 and Operation Iraqi Freedom also make it vital that the United States does not let its dedicated MCM force atrophy in lieu of the new organic concept. Coalitions of the willing that have the right skill sets may be harder to come by in future contingencies, and even NATO allies may prove reluctant to

48 Goodman, David. Value and Promise of the UUV and AUV: Unmanned Undersea Vehicles and Autonomous Underwater Vehicles Assessed. NAVAL FORCES. No.III/2004, Vol. XXV.

49 Mark Ferror, Foreign Military Sales: Spanish LAMPS: Lighting the Way. Aviation Today. [online] Available: http://www.aviationtoday.com/cgi/rw/show_mag.cgi?pub=rw&mon=0403&file=0403sh60b.htm Accessed: 11 February 2005.

support U.S. operations. Therefore, the United States Navy cannot afford to slip back to the Cold War relationship of European NATO MCM as the answer for dedicated, theater mine clearance operations.

IV. CASE STUDIES

A. NATO/COALITION NEAR-AREA MCM OPERATIONS

NATO operations have encompassed missions within the European and Atlantic regions and beyond, requiring varying levels of commitment and capability. As NATO moves from an organization dedicated to Western defense to a guarantor of international security, a role which it appears to be slowly assuming with the creation of the NRF, there are many potential operations that planners must be prepared to respond to including security of vital SLOCS and chokepoints throughout the world. It is through these strategic areas that maritime commerce flows and naval forces responding to international crises must transit. These areas could be mined by adversaries wishing to deny access for economic or political reasons. Figure 3 depicts some of the more heavily used chokepoints in the maritime domain.⁵⁰ Some of these chokepoints have already been the scene of mining in the past.

Eastern Mediterranean and Persian Gulf	Eastern Pacific	Europe	Africa	The Americas
Bosporus	Strait of Malacca	Great Belt	Mozambique	Panama Canal
Dardanelles	Sunda Strait	Kiel Canal	Channel	Cabot Strait
Suez Canal	Lombok Strait	Dover Strait		Florida Straits
Strait of Hormuz	Luzon Strait	Strait of Gibraltar		Yucatan Channel
Bab-el Mandab	Singapore Strait			Windward Passage
	Makassar Strait			Mona Passage

Figure 6. Worldwide Vital Chokepoints

Within the past 20 years, there have been several incidents and operations that have challenged NATO MCM specialists. More recent *near-area* operations include the Red Sea/Suez Canal mining incident in the summer of 1984 and Operations Allied Harvest I/II in the Adriatic Sea in 1999-2000 in which MCM forces were tasked with

⁵⁰ Donna J. Nincic, *Sea Lane Security and U.S. Maritime Trade: Chokepoints as Scarce Resources in Globalization and Maritime Power*. Edited by Sam J. Tangredi. (Washington: NDU press, 2002), CH 8.

locating and neutralizing unexploded ordinance from the NATO air campaign in Kosovo. *Out of area* MCM operations (that have included NATO members serving as part of other coalitions) included Operations Earnest Will during the Iran-Iraq war, Desert Storm in 1991 and Operation Iraqi Freedom in 2003. While there have been other instances where live mines have been located and neutralized (such as during Balkan exercises, these have been more limited in scope and were not the result of recent hostilities

1. Red Sea/Suez Mining Incident of 1984

In the summer of 1984, freedom of navigation was challenged through the Red Sea and Suez Canal through a campaign of naval mining. Initially, Islamic Jihad claimed responsibility for deploying mines in the Suez approaches and the Southern entrance to the Red Sea, but it became apparent (though not actually proven) based on the scope of the mining and other information that the actual culprit was the Libyan commercial vessel *Ghat*, a Roll-on/Roll-off ship that had transited North and South through the Red Sea and the Gulf of Suez. As a result of the indiscriminate use of mines, 19 merchant vessels from 15 different countries were struck and damaged, creating a state of near panic and sending maritime insurance rates sky high.⁵¹ While a few of the mine strikes were suspect and one was later determined to be insurance fraud, the fact remained that a vital sea lane of communication had been mined in an overt act of maritime terrorism. The United States, along with several other countries, both NATO allies and not, responded to begin minehunting and sweeping operations. Although NATO did not officially respond, forces that belonged to NATO countries under the auspices of the WEU conducted hunting and clearance operations that yielded WWII era mines, a more advanced Soviet combined-influence bottom mine that the USSR was then exporting, and numerous other variants of bottom mines. Table 2 illustrates the extent of the mine strikes and the vicinities where the strikes occurred while Figure 5 depicts the approximate location within the Red Sea region.

⁵¹ Gregory K Hartmann and Scott C. Truver, *Weapons That Wait: Mine Warfare in the U.S. Navy*. Updated Edition. (Annapolis: Naval Institute Press, 1991) pg. 250

Table 2. Red Sea/Gulf of Suez “Mines of August” Incidents (1984)⁵²

Date	Ship	Area
9 July	Knud Jespersen (Soviet)	North Gulf of Suez
27 July	Este (West Germany)	South West Gulf of Suez
	Medi Sea (Liberian)	North East Gulf of Suez
	Meiyo Maru (Japanese)	North East Gulf of Suez
28 July	Bogorange XII (Panamanian)	South East Gulf of Suez
	Linera (Cypriot)	South West Gulf of Suez
31 July	Hui Yang (Chinese)	South Red Sea/Bab el Mandeb
	Peruvian Reefer (Bahamian)	South Red Sea/Bab el Mandeb
	Valencia (Spanish)	Gulf of Suez
2 August	Kriti Coral (Panamanian)	South Red Sea/Bab el Mandeb
	Morgul (Turkish)	South Red Sea/Bab el Mandeb
	Dai Hong Dan (North Korean)	South Red Sea/Bab el Mandeb
	George Shumann (East German)	South Red Sea/Bab el Mandeb
3 August	Tang He (Chinese)	South Red Sea/Bab el Mandeb
5 August	Oceanic Energy (Liberian)*	South Central Red Sea
6 August	Bastion (Soviet)	South Red Sea/Bab el Mandeb
11 August	Jozef Wybicki (Polish)	Bab el Mandeb
15 August	Theopoulis (Greek)	South Red Sea/Bab el Mandeb
30 September	Belkis I (Saudi Arabian)	North Gulf of Suez

⁵² Gregory K Hartmann and Scott C. Truver, *Weapons That Wait: Mine Warfare in the U.S. Navy*. Updated Edition. (Annapolis: Naval Institute Press, 1991) pg. 251.

* Oceanic Energy was later assessed by commercial surveyors and U.S. Navy to be a case of possible insurance fraud.



Figure 7. Approximate location of mine strikes during Mines of August Crisis.

During the clearance operations, dubbed “Operation Intense Look”, U.S., British, French, Italian and Dutch MCM forces had an opportunity not only to hone their skills, but also to introduce new systems such as the U.S. Navy’s AN/SQS-14 side-scan sonar towed by *Sea Stallion* Airborne Mine Countermeasures (AMCM) aircraft. In addition to hunting, these aircraft also conducted extensive sweeping operations. One of the outcomes of the de-mining operation was the realization that, in order to carry out effective MCM operations in vital areas of interest, there had to be some advanced knowledge of what the seabed floor looked like. What the forces found when they arrived on station was a sea bed full of mine-like contacts that were actually huge amounts of man-made debris, including a refrigerator in one case. This would eventually lead to the creation of continuously updated databases of survey data (in areas of interest) that could be used by mine forces in the event of mining activity. They could review the databases and compare them to what they were currently seeing to make the effort more efficient. While multi-national mine forces responded to combat the threat, there was no

coordination or unity of effort. Forces conducted clearance operations in their areas, but even NATO members did not conduct combined clearance operations.

2. Operation Allied Harvest

On March 23, 1999, after continued reports of ethnic cleansing and atrocities and a failure to reach a political resolution of the conflict, NATO launched Operation Allied Force, in an effort to stop the conflict between Serbian forces under the direction of Slobodan Milosevic and the Kosovar Albanians in Kosovo. The result was an intense 78-day air campaign including Tomahawk missile strikes U.S. Navy surface combatants. During the campaign, unexploded munitions were at times jettisoned in designated areas in the Adriatic Sea. At the conclusion of the conflict in June 1999, two NATO MCM forces, MCMFORNORTH and MCMFORMED, began Operation Allied Harvest, an effort to recover and neutralize some 145 unexploded bombs that had been dropped by allied aircraft in the Northern Adriatic. In April 2000, after fishing boat near Chioggia, Italy hauled in a bomb which subsequently exploded, NATO returned at the request of Italy, to conduct Allied Harvest II. This lasted through September 2000 and focused on eight specific areas in the Northern Adriatic Sea.⁵³ Throughout the course of the operations, NATO MCM forces located and neutralized unexploded ordinance and several vintage mines. Of equal importance for NATO, the Balkans conflict and subsequent mine operations allowed for the birth of a second standing MCM force which was then headquartered in La Spezia, Italy.

B. NATO/COALITION OUT OF AREA MCM OPERATIONS

Operation Enduring Freedom saw the first actual use of NATO forces under the auspices of NATO in out-of-area operations. However, MCM forces had deployed to the Persian Gulf during the Iran-Iraq War in the 1980's as a Western European Union (WEU) force when it became clear that the Iranian's indiscriminate use of mines within the Persian Gulf, Strait of Hormuz and the Gulf of Oman could have significant economic ramifications for Europe which relied heavily on Persian Gulf energy resources.

⁵³ Guy Toremans, Standing Ready for NATO. Jane's Navy International, May 2004. [Online] Available from: <http://www4.janes.com/K2/doc>. Accessed 21 April 2005.

1. Operation Earnest Will

In 1987, *Operation Earnest Will* began as a U.S. escort operation for 11 Kuwaiti oil tankers during the Iran-Iraq War after the Iranians decided to strike indirectly at Iraq (who had also been attacking Iranian tankers) by attacking oil tankers carrying oil from the Gulf States (that were supporting Saddam Hussein.) In late 1986, Iran began a systematic attack on Kuwaiti ships. By 1987, over forty neutral tankers had been attacked.⁵⁴ Following requests by Kuwait and an intense period of negotiations, the United States reflagged 11 tankers and began escort operations. During its first escort, the super tanker Bridgeton struck an Iranian mine. Prior to that, there had been four reported mine strikes within an 80 mile area. More mines were discovered south of where Bridgeton was struck, and in July, another seven were located. The U.S. approached the U.N. for assistance and appealed to its European allies to help, but with no luck. Finally, when Iranian mines were discovered outside the Gulf, the Europeans realized their interests were also in jeopardy as the conflict continued to escalate. In August 1987, Britain and France deployed minesweepers followed by Belgium and the Netherlands. After an Italian tanker struck a mine in September 1987, the Italians also deployed MCM forces.

Under the auspices of the WEU, MCM forces began clearance operations in earnest by September 1987 focusing mainly on areas outside the Gulf while U.S. and Gulf state MCM forces focused within. Individual nations controlled their respective flotillas with some coordinated operations, especially between the British and Dutch. The Tanker War highlighted the lack of unity and political will that initially existed between Western allies. Without a specific U.N. mandate for action, European forces were unwilling to involve their forces until their direct interests were at stake. Even then, it took some time to mobilize and deploy forces to respond. The United States' poor MCM capability and planning was symptomatic of the general lack of concern about the mine as a viable threat to modern naval forces. This was surprising in light of the recent experiences in the Red Sea and Gulf of Suez in 1984. The U.S. believed, incorrectly, that

⁵⁴ Palmer, Michael A. *Guardians of the Gulf: A History of America's Expanding Role in the Persian Gulf, 1833-1992*. (New York: The Free press, 1992). Pg 121.

its mere presence in the Gulf would serve as deterrence to mining, and if that didn't work, their persistent surveillance and intelligence would allow them to preempt the deployment of mines.⁵⁵ This line of logic failed to take into account the ease and flexibility with which mines can be deployed. The Iranian Revolutionary Guards deployed approximately 100-150 M-08/39 contact mines out of an estimated 1,000 in their inventory.⁵⁶ If not for the Western allies and their newer and more capable MCM vessels, the U.S. would have been incapable of conducting effective MCM operations in the region. As was evident, that cooperation was never guaranteed.

2. Operation Desert Storm

In 1990-91, the United States and Coalition forces launched Operation Desert Storm to liberate Kuwait from Iraqi forces. Prior to Desert Storm, Iraqi forces had invaded neighboring Kuwait and occupied the territory for five months. While the U.N. demanded Iraq's withdrawal and continued to apply diplomatic pressure, the United States began building an international coalition to respond, in which NATO countries and forces were heavily represented.

During the long run-up to the war, Iraqi naval forces were able to lay extensive minefields in a 150-mile arc from Faylaka Island to the Saudi-Kuwaiti border (see figure 6).⁵⁷ The United States and coalition planners suspected that this was happening but could not get political concurrence to conduct preemptive military action against Iraqi mine-laying forces. This failure to respond to the mining effort before mines went into the water was to come back and haunt the United States which would suffer two mine strikes to the *USS Princeton* and *USS Tripoli*.

55 Palmer, Michael A. *Guardians of the Gulf: A History of America's Expanding Role in the Persian Gulf, 1833-1992*. (New York: The Free press, 1992). Pg 136.

56 Gregory K Hartmann and Scott C. Truver. *Weapons That Wait: Mine Warfare in the U.S. Navy*. Updated Edition. (Annapolis: Naval Institute Press, 1991), pg 245.

57 Department of Defense, *Conduct of the Persian Gulf War, 1992*. [Online] Available from: http://www.geocities.com/Pentagon/Bunker/2170/desertshield_desertstorm.html. Accessed 21 April 2005.

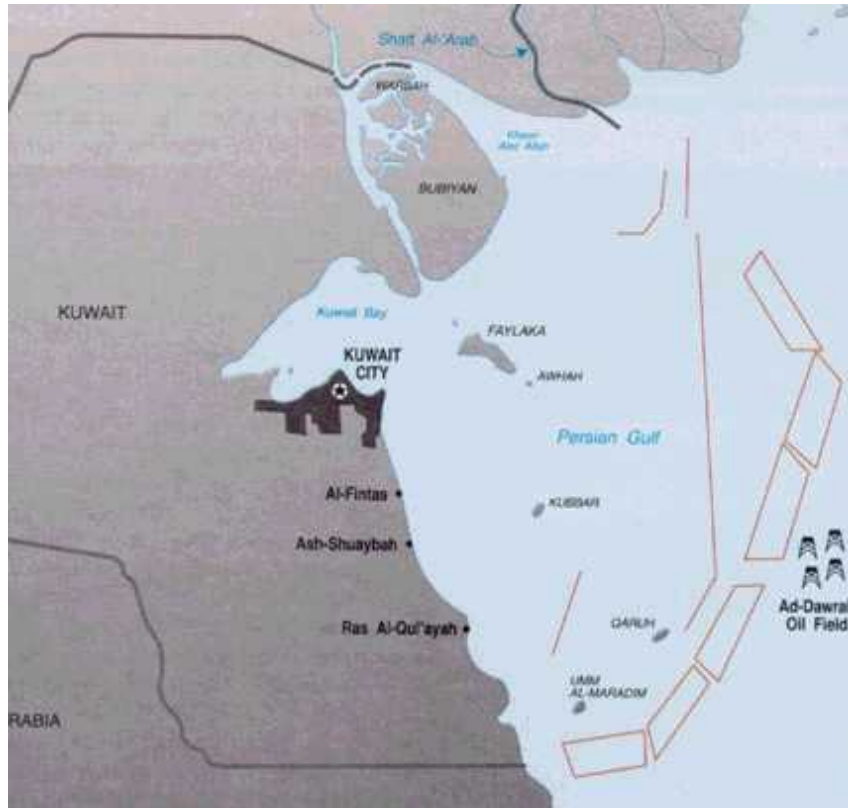


Figure 8. Location of Iraqi Mines during Desert Shield/Storm.⁵⁸

The combined damage to the two ships totaled approximately \$21.6 million, and was caused by three mines whose total cost was under \$25,000. The cruiser *USS Princeton* actuated two Italian-made manta influence mines while the helicopter landing ship *USS Tripoli*, which was serving as the MCM command and control ship, struck a moored contact mine. In addition to those casualties, plans for an amphibious assault against Iraqi forces in Kuwait were cancelled in part because of the seeding of some 1,300 mines in the coastal waters.⁵⁹ Once again, the United States was wholly unprepared for the mine threat even though it had had ample time in this case to get ready. European MCM forces (with the exception of Britain), were not able to assist in clearance operations until the end of hostilities so even though they deployed to the region, they

⁵⁸ Department of Defense, *Conduct of the Persian Gulf War*, 1992. [Online] Available from: http://www.geocities.com/Pentagon/Bunker/2170/desertshield_desertstorm.html. Accessed 21 April 2005.

⁵⁹ RADM Paul J. Ryan and Scott C Truver. *U.S. Navy Mine Warfare Vision... Programmes... Operations: Key to Sea Power in the 21st Century*. NAVAL FORCES No 3, Vol. 24, pg 28

were of little help during the conflict.⁶⁰ The MCM effort eventually included France, Belgium, Italy, Germany, the Netherlands, Britain, the United States, and Japan, but it enjoyed little coordination due to varying tactics, doctrine and national directives. At the conclusion of Desert Storm and after reviewing the shortfalls, senior U.S. Navy leaders vowed to correct the deficiencies in the U.S. Mine Warfare force structure that led to the difficulties experienced during the campaign. 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.⁶¹

While Desert Storm highlighted shortfalls in the U.S. structure, it also validated systems such as Germany's "Troika" (unmanned remote-operated influence sweeps) and made multi-national MCM planners more determined to conduct coordinated training and operations to improve interoperability.

3. Operation Iraqi Freedom

The most recent operations that saw NATO member navies involved in MCM operations were Operations Enduring Freedom and Iraqi Freedom. The political dissent among NATO members about the validity of the war with Iraq prevented most NATO allies from sending naval forces to the Persian Gulf. In early 2003, at the request of the United States 6th Fleet, NATO did send an MCM Task Group to the Northern approaches of the Suez Canal in support of *Operation Enduring Freedom (OEF)*. Since OEF was supported by NATO, this was politically acceptable. Along with the U.S. Mine Warfare Readiness Group Three (MIWRG3), the NATO force conducted route survey and presence operations to deter mining in the SLOC/chokepoint that would once again prove vital to U.S. operations.

⁶⁰ House Armed Services Committee, *Defense for a New era: Lessons of the Gulf War*, 1992, pg.27

⁶¹ CAPT Gregory J. Cornish, *U.S. Naval Mine Warfare Strategy: Analysis of the Way Ahead.. U.S. Army War College*, Carlisle, PA. 2003.

During the opening months of the conflict, the U.S. Military Sealift Command sailed and chartered more than 210 ships and moved 94 percent of the nation's joint and combined capability to the fight.⁶² The heavy reliance on strategic sea lift to transport troops, logistics and materiel into the theater of operations necessitated unimpeded access through numerous sea lines of communication. The narrow choke points of the Straits of Gibraltar, the Suez Canal, and the Strait of Hormuz were critical in the free flow of troops and gear into and around Iraq and to support operations in Afghanistan. Even with those chokepoints secure, the continued ability to operate with impunity was vital for sustaining operations, both combat and humanitarian.

In addition to the ongoing survey operations by NATO forces in the Mediterranean, in March 2003, as coalition forces continued offensive operations against Iraq, more than 68 mines were located and destroyed in Iraqi coastal waters by a combined U.S., British and Australian MCM force.⁶³ As previously discussed, an Iraqi tugboat which had been converted into a minelayer, was captured by Australian forces with dozens of contact and influence mines onboard. From the Northern approaches of the Suez Canal to the littorals of Iraq, coalition forces conducted various types of sustained mine warfare operations in support of Operation Iraqi Freedom. During this period, many new MCM systems were fielded to aid in the operations. One new system that was successfully utilized during OIF was the Autonomous Underwater Vehicle (AUV). The AUV is a multi-purpose autonomous underwater vehicle. While this technology is technically still in the research phase, 6 Remote Environmental Monitoring System (REMUS) AUV's were used successfully for providing reconnaissance and assisting with clearance operations in the Northern Persian Gulf near Umm Qasr during Iraqi Freedom. MCM forces were able to leverage the advantage of the new systems to maintain long on station times, (up to 22 hours at 3 knots or 8 hours at 5 knots), which allowed for coverage up to 60 nm in a single mission, at depths to 100 meters.⁶⁴

62 Admiral Vern Clark, Chief of Naval Operations. *Credible Combat Power: Around the World...Around the Clock* Speech to the Senate Armed Services Committee on 12 February, 2004.

63 Massimo Anati, Mine Hunting and Mine Clearing Revisited: A Review of Current Operational, Technological, and Commercial Trends. (Military Technology, Aug/Sep 2003, No 27) pg 48.

64 Massimo Anati, Mine Hunting and Mine Clearing Revisited: A Review of Current Operational, Technological, and Commercial Trends. (Military Technology, Aug/Sep 2003, No 27) pg 57.

The mining that had been experienced during the first Gulf war was not repeated due to over a decade of sanctions, but this time the U.S., with its British and Australian allies were prepared to defeat any threat. While there was not a large coordination effort among U.S. and European navies due to limited support by the latter, OIF validated the utility of the new family of MCM capabilities including AMCM, drones, UUV, AUV, and remote-operated one shot destructors such as SEA FOX. Unfortunately, it also highlighted some problems that still exist. In the eastern Mediterranean, the NATO force and the U.S. force did not interact.⁶⁵ Had these forces been required to engage in joint clearance operations in the Red Sea or Suez vicinity, the absence of any joint planning would certainly have complicated, and perhaps compromised, the mission. The lessons learned from previous operations seemed to have once again vanished and an opportunity to coordinate unity of effort (with the notable exception of U.S. and British forces in the Gulf) was once again squandered.

C. CONCLUSION

The various case studies discussed highlight the operational challenges that NATO MCM forces have faced over the past few decades. As NATO members have addressed the mine threat in different contingencies, they have developed new technologies and doctrine to meet the challenges. Unfortunately, as has been seen, there are still some significant shortfalls that have not been sufficiently addressed. The inability of NATO forces to work from a common operational picture in real time is just one of the problems. As new technologies, such as UUVs, continue to be introduced that will provide rapid contact data, the ability to quickly and accurately disseminate this information is critical. Additionally, it is vital that all NATO partners with MCM capabilities interact more fully through cross-decking, professional schools, and exercises to ensure effective interoperability. Even after relying so heavily on European NATO MCM forces in the past, the United States still does not have a ship assigned to either of

⁶⁵ LCDR Martin Schwarz (German Navy MIW Officer). PEP Officer assigned to U.S. CMWC N-8. Interview conducted on 30 March 2005 at NAS Corpus Christi, TX. This observation was also made by the author who served as a Tactical Action Officer aboard USS CHIEF (MCM14) while conducting survey operations in the same vicinity as LCDR Schwarz.

the standing NATO MCM groups. With the U.S. leading the drive toward organic mine countermeasures and as the only member with aviation assets, the United States plays a key role in MCM and yet, by not permanently assigning forces to work with its European peers, it is missing an opportunity to enhance operational expertise among its own forces. The United States should participate actively in the MCM groups much like it does with Standing Naval Forces Atlantic (SNFL) and Standing Naval Forces Mediterranean (SNFM). This would expose crews to European tactics and doctrine and in the event of future contingencies, ensure sound working relationships which in many aspects, do not currently exist.

Finally, the lessons learned from these past operations would seem to indicate that the only way to effectively address a large mine threat is through the coordinated use of all aspects of mine warfare capability, both offensive and defensive. This means that there must be the political will to stop mines from entering the water in the first place and when that fails, there must be sufficient capability to respond to any threat. Immediately prior to Desert Storm, intelligence personnel knew that Iraq was seeding mines in the littorals and yet there was no political will to preempt this action. This necessitated the MCM response which was a day late and a dollar short. The strategic significance of the Middle Eastern region makes it likely that it will be the site of future contingencies involving NATO countries. One only has to look at the past operations to understand the future implications.

V. CONCLUSION

In the past two decades, NATO member countries have conducted numerous MCM operations both in and out of area as NATO task groups or as members of other coalitions. These operations have included every facet of MCM from conducting route surveys and presence operations to hunting individual mines laid by non-state actors. They have included clean-up operations of unexploded munitions to prosecuting more traditional complex minefields. Additionally, the operations have included traditional mechanical and influence sweeps to hunting with advanced remote-operated vehicles, unmanned underwater vehicles, and marine mammals. Throughout these experiences, NATO navies have faced a vast array of mine technologies from WWI-era contact mines up to today's advanced multi-influence mines. The case studies have provided the reader with a broad swath of capabilities that have been used to counter a wide array of threats deployed traditionally and asymmetrically. They have also provided insight into what seems to be a persistent and intractable dilemma.

NATO navies (particularly European navies) continue to conduct out of area operations with forces designed for near area operations. Without forward basing (which is unlikely for most), the dilemma of response time still remains (even in the 21st century) for an organization that is increasingly taking on an expeditionary role and that has recently entered into discussion with the United Nations to play a larger role in stability operations. With the exception of the United States, no NATO navy has an AMCM capability integrated into its quickest type of reaction force, nor are there any plans to do so based on both fiscal constraints and the belief that AMCM is not effective enough to justify the expense.⁶⁶ Since one of the major problems with the mine threat is time, there seems to be a problem with what NATO *wants* to do and what it *can effectively* do. If the NATO Response Force (NRF) is truly going to be an expeditionary force that can rapidly respond to emerging crises, it will not be able to afford the consequences of having to face a potential mine threat with yesterday's MCM capabilities. While there have been

⁶⁶ CDR Nico Vasseur, Commander SNMCMGROUP1. E-mail response/correspondence dated 09 March 2005 concerning NATO MCM capabilities. Available: nlmcmops@navy.dnet.mindef.nl.

noteworthy advances in UUV technology, European NATO members need to more fully embrace a wide array of organic capabilities to allow their expeditionary forces an in-stride MCM capability. This is an area that needs to be further explored as defense planners recommend how to spend the limited defense budgets that are a part of the post-Cold War paradigm.

Proliferation of advanced mine technology continues to be one of the gravest dangers facing NATO countries. Rapid advances in electronics technology coupled with the inability to adequately track naval mine transfers make these weapons an attractive choice, especially against today's powerful Western navies. While intelligence agencies are tasked with monitoring stockpiles of naval mines throughout the world, the tracking of naval mines as part of *legal* arms transfers is virtually non-existent. That is not to say that there is nothing in place to discourage the sale of these weapons to potentially belligerent regimes. The Wassenaar Arrangement is a step in the right direction. The problem is that it is not internationally binding and leaves a lot of leeway for the members to continue sales. This is evident by the way naval mines are still "actively marketed at numerous exhibitions and arms shows around the world."⁶⁷ With little control of these dangerous weapons, the potential for maritime terrorism with mines has increased dramatically. Mines are just as easy for terrorists to employ in a nation's homeports as they are for state actors to seed in their own littorals.

Even as this problem is acknowledged among naval professionals, there has been no meaningful attempt to address this challenge. What is even more disturbing is that Western countries, even members of security arrangements such as the Wassenaar Arrangement, have continued to fill the orders of many developing countries wishing to expand their mine stock piles with no guarantee that these arms will not end up on the black markets that have surged since the end of the Cold War. While the EU considers lifting the arms embargo on China (with some countries more vociferously advocating this), China continues to supply advanced weapons to countries like Iran. An example of this is with recent reports that Iran has negotiated with China to purchase the EM-52 or

⁶⁷ Gordon Scott Price, U.S. CMWC N-8 and the U.S. Head of Delegation for the NATO Naval Mine Warfare Working Group. 10 May 2005.

MN-52 rocket-propelled mine to add to their current mine inventory which is estimated to be around 2,000 mines of various designs.⁶⁸ As tensions continue to build with Iran over their nuclear intentions, the fact that they could once again shut down the Strait of Hormuz (a vital SLOC for the transportation of oil) with these extremely lethal weapons should be an impetus for change in conventional arms transfer regimes.

Finally, history has shown that, regardless of whether a potential operation is *near-area* or *out-of-area*, NATO as an organization may not have the political will (as a function of its individual governments) to coordinate a timely response. Resulting MCM efforts, when they occur, will thus suffer from the inefficiencies and difficulties that are inevitable in any *ad hoc*, extemporized military operation. Precisely because many of these countries have niche (as distinct from general) MCM capabilities, a response coordinated at the alliance level becomes especially important. One only has to look back at *Operation Earnest Will* to see that unless there is a perceived direct threat to particular nations' interests, NATO members may choose not to become involved militarily in future contingencies. In this regard, the United States, as the preponderant military power within NATO, must ensure that it develops sufficient capability to address future mine threats without undue reliance on European allies. This means that there must be a balance between maintaining the dedicated mine force and developing organic forces. The current Navy 30-Year Plan that is under discussion does not adequately address this need. By 2024 in both its 260 and 325-ship options, dedicated mine warfare ships are gone, replaced by the mission-reconfigurable LCS platforms.⁶⁹ This complete shift from dedicated MCM forces could actually serve to water-down MIW expertise in the U.S. Navy, a force that still does not have dedicated mine warfare career tracks for its officers like its European peers. Likewise, it is incumbent that European NATO MCM forces develop additional organic capability, especially AMCM. While there has been an indication by some that AMCM does not deliver the necessary bang for the buck, there

⁶⁸ Anthony H. Cordesman, *The Military Balance in the Gulf: The Dynamics of Force Developments*. Center for Strategic and International Studies Working Draft: Revised April 13, 2005. [Online] Available from: http://csis.org/burke/mb/050413_MEMilBalGulf.pdf Accessed 04 May 2005.

⁶⁹ Christopher P. Cavas, *U.S. Navy Sets 30-Year Plan*. Defense News. Vol. 20, No. 13. March 28, 2005.

can be little doubt of the utility AMCM serves as first responders for expeditionary forces. This more balanced approach among the MCM forces will ensure a robust NATO response without a marked capabilities gap for future mine countermeasure operations, wherever and whenever they may occur.

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