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How Vulnerable are U.S. Critical Seaports to a Waterborne Mine Threat?

By

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

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

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14 February 2005

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ABSTRACT

The events of 11 September 2001 illustrate Al Qaeda's high aspirations and desire to achieve maximum effect. Halting most or all shipping traffic to and from the United States, if only for a short time, would achieve such an effect. Terrorists may have drawn lessons from recent history, such as the 1990-91 Gulf War and the 1980s Tanker War, with regard to naval mines. Mines are a simple, inexpensive, asymmetric threat that could be used to cause enormous economic damage to the United States. The probability of terrorists resorting to waterborne mining is almost impossible to determine. However, one can determine and implement measures aimed at reducing United States' vulnerability. Examination of the possible effects, should deterrence fail, would also allow one to determine and implement a reasonable, well-prepared course of action to mitigate those effects.

Introduction

Imagine if, through the Al Jazeera television network, Usama Bin Ladin announced that Al Qaeda had placed a sea mine in port of New York waters. The events of 11 September 2001 illustrate Al Qaeda's high aspirations and desire to achieve maximum effect. Halting most or all shipping traffic to and from the United States, if only for a short time, would achieve such an effect.

Recent history illustrates hard lessons for the United States with regard to naval mining. One need only review the 1980s Tanker War and the 1990-91 Gulf War to make this assertion. The salient lesson is that once mines are in the water, great effort must be expended to find and remove them. Mines are still in the north Arabian Gulf from a war fourteen years ago. Because so much effort would be required to remove them, such danger areas are now simply avoided.¹ Ironically, Operation *Iraqi Freedom* illustrates this point because OIF had to be fought *around* mine danger areas established in the first Gulf War. OIF also illustrates that one does not always have to clear out mine fields completely, but may isolate them to reduce risk sufficiently. That said, the compelling lesson learned is to prevent mines from being seeded in the first place. Prevention is usually not possible with a determined enemy, particularly when any small vessel, such as a fishing dhow, can be used to seed mines. During the Tanker War in July 1987, U.S. authorities were well aware of the mine threat posed by Iranian forces as evidenced by the intensive mine countermeasures being conducted by the United States, Kuwait, and Saudi Arabia at the time. Yet, MV *Bridgeton*, under U.S. escort, still struck a mine.²

Terrorists may have learned lessons of their own from recent history. Perhaps one is that naval mines have exposed a soft spot, one that can be exploited to great effect, in the

underbelly of U.S. defenses. Another might be that great effect can be achieved if a mine's location is ambiguous, further complicating its location and removal. Yet another might be that one need not seed any mines, but only claim that mines had been seeded to stop maritime shipping temporarily into and out of the United States.

The consequences of such a claim would be far-reaching. Naturally, risk analysis would ensue from the local to the national level in the United States. Any nation with a flagged ship destined for the United States would do its own risk analysis. Insurance companies, businesses—both U.S. and foreign—shipping or receiving merchandise, and merchant ship owners would have their own considerations. Confidence, or lack thereof, in U.S. port safety would be influenced largely by U.S. response. What information would U.S. authorities need to respond properly? Is that information available today?

This paper examines whether the United States is adequately prepared to prevent or respond to the waterborne mining of a major U.S. port, and argues that the United States is not. The U.S. mine countermeasures capability may be the best in the world, but that does not mean the United States is as prepared as it could be.

It will be shown that terrorists can acquire and seed mines in U.S. port waters, that closure of a single major port would cost the United States billions of dollars per day, and that it is possible, with proper preparation, to reduce markedly risk and time required to respond to such a threat.

To examine the problem, one must first know the nature of the threat. How might terrorists acquire and seed mines in U.S. waters and what would be the effects? Second, what is effective deterrence and are U.S. measures adequate? Third, what is effective response and are U.S. authorities taking adequate measures to provide such response?

Assessing the Threat

Mine Acquisition and Expertise. Waterborne mining is quite economical in contrast to other methods that could be used to like effect.³ Specifically, mining offers perpetrators the opportunity to achieve an extremely large bang and significant effects “for the buck.” In like manner, gaining the knowledge to acquire, transport, and employ mines is much simpler than the effort required to hijack commercial aircraft and employ them as missiles, or to procure and employ chemical, biological, or radiological (CBR) weapons. The most challenging aspect of the mine employment mission is to ensure the plan is suitable, i.e., that it will achieve the desired outcome in terms of placement and timing.

In 1864, David Farragut’s words, “Damn the torpedoes,”⁴ immortalized him for his unwillingness to allow unsophisticated, floating explosive devices to deter him from his mission to defeat the Confederate forces at Mobile Bay. One hundred forty years later, most mines are still simple devices, admittedly with more detonation features than those faced by Farragut, but there are many more of them such that quantity has “a quality all its own.” Few if any modern mariners are willing to assume the risk inherent to, “Damn the torpedoes.”

Naval mines are available globally. But mine stockpiles throughout the world, and particularly their movement, are not monitored with any vigor, as compared to CBR weapons. About fifty navies deploy mines, thirty-two countries produce them, and twenty-four countries export them.⁵ Iran is a good example, particularly since its links to terrorism are well-known. Iran possesses a robust naval mining capability, and was known to be negotiating in 2002 with China to acquire the EM-52 rising-mine.⁶ The EM-52 is a menacing threat, but generally too large and sophisticated for stealthy transport and quick use with minimal training. However, this does indicate Iran’s familiarity with, and growing

expertise in, naval mining. Exclusive of the EM-52, Iran possesses globally common mines that are easy to transport and employ. In all, it is estimated that Iran may possess nearly three thousand mines⁷ and may be producing its own, to include remote-controlled mines.⁸

Pre-OIF Iraq “had a diverse inventory of moored-contact and bottom-influence mines acquired from a variety of sources. It may also have indigenously produced both types of mines, by reverse engineering them from foreign models. Although the Iraqi Navy did not have a sophisticated mine warfare doctrine or dedicated mine-laying platforms, practically any ship can carry and deploy mines.”⁹ Research conducted for this paper could not determine the disposition of Iraq’s pre-OIF mine inventory, particularly who now may possess it.

Movement and Delivery. Small mines would be most attractive to terrorists. U.S. Congressional attention has been focused specifically on Point of Origin Cargo Security,¹⁰ so the likelihood of large cargo vessels being inspected at point of origin is increasing daily. In contrast, mines can be easily hand-carried by two or three individuals and transshipped on small vessels. The widely available Italian-made Manta, for instance, weighs just 485 pounds, is 17 inches in height, and 38 inches in diameter.¹¹ The simplest method of transportation is to move the mine via small vessel onto a larger cargo vessel after leaving point of origin, an action in all likelihood going undetected. The mine could then be deployed by simply shoving it over the stern—probably at night—before the larger vessel reached port, effectively bypassing the destination inspection process.

The Effects of Mining. Generally speaking, in naval warfare mines are used as force multipliers to prevent shipping from using certain areas, or to channel shipping into areas that make the circumstances more favorable for the entity employing the mines. Terrorist intent most likely would be to paralyze shipping into or out of the United States, at least temporarily, to cause enormous economic damage. It will be shown that one mine alone can be temporarily as effective as one hundred of the same. Given this, and the large number of targets available in the United States, it would not take long to conceive and execute a shipping paralysis plan.

Since the events of 9-11, there has been much public discussion on the lack of U.S. port security. However, in the volumes of data, articles, and books on the subject, mining is not mentioned at all. Most discussion addresses the inadequacy of container security, and the concern with locating and preventing weapons of mass destruction (WMD) from entering the United States through our ports. Even if container security were one hundred percent assured, terrorist mining could still occur. WMD are an extremely dangerous threat, certainly of higher concern than mining. Or are they? Could terrorists cause more economic damage by shutting down the nation's ports for a longer period of time with mines instead of WMD? Might they get better effects from WMD used elsewhere? Of course, the human and environmental impact of WMD would be much more extensive, but it probably requires much less time to search ports for WMD than to search ports and their associated approaches for waterborne mines. In fact, the Department of Homeland Security has already established Maritime Safety and Security Teams (MSSTs), specially trained in detecting WMD.¹²

U.S. Ports. U.S. critical seaports are very vulnerable to waterborne mines in internal waters and the approaching shipping lanes. The enormous size and accessibility of major U.S. ports, coupled with the wide-ranging threats¹³ terrorists can pose, make defense against such terrorist acts understandably very difficult.

Effects of port closure due to mines would be significant. In 2003, total U.S. waterborne foreign trade was \$807 billion.¹⁴ Los Angeles is highest with \$122 billion¹⁵ Next closest is New York at just under \$101 billion.¹⁶ The Port of Los Angeles provides a good example of closure effects. “By one estimate, the cost to the U.S. economy of the recent port closures on the West Coast due to labor-management dispute was approximately \$1 billion per day for the first five days, rising sharply thereafter.”¹⁷ This occurs as follows. Wide-spread business practice is to conduct “just-in-time” inventory management.¹⁸ It is highly synchronized shipping and stocking that time goods to arrive just as they are needed. It results in substantial cost savings, allowing manufacturers to maintain smaller inventories and warehouse space. This distribution model has achieved a reduction in business logistics costs from 16.1 percent of U.S. GDP to 10.1 percent between 1980 and 2000.¹⁹ The ripple effect of process interruption, even for only a day or two, would cause production to halt for many U.S. businesses.

In addition to strictly economic effects, there would be strategic-military effects as well. Norfolk, Virginia, is an example. To reach the Norfolk area port complex, shipping traffic must pass over the Chesapeake Bay Bridge Tunnel—the entrance to Chesapeake Bay—and the Hampton Roads Bridge Tunnel—the sole entrance and exit to Norfolk, Portsmouth, Naval Station Norfolk, and Newport News Shipbuilding. Because Norfolk area foreign trade totaled over \$34.4 billion in 2003,²⁰ the closure of this channel would have huge economic

implications. It would have important strategic implications as well, depending on how many Navy ships were in port, because Norfolk is a major aircraft carrier, surface combatant, and submarine base. In addition to possible shipping damage and associated environmental effects, the detonation of a mine in the vicinity of the tunnels would kill many motorists, depending on the time of day and amount of traffic at the time, and close the tunnel for an extremely long period of time. The economic effects of severing that ground transportation route would be difficult to calculate, although shipping channel traffic could probably resume after only a short period of time.

To achieve maximum effect, here is an example of what a terrorist could easily plan and execute. Acquire and place one mine in the waters of a major U.S. port, then patiently wait for detonation. Following detonation, immediately announce that mines have been placed in two or three other major ports, leaving it to authorities to figure out which ports. Only three is quite reasonable. To claim any more might seem unrealistic. *Key here is that it is not necessary to acquire or place the additional three mines.* To actually acquire and deploy the additional ones would greatly increase the chances of being caught. But one could, with only a single mine, temporarily paralyze all U.S. ports, creating a huge financial impact. How long would it take to reopen U.S. ports? How high would insurance rates skyrocket as result?

Effective Deterrence

What is Effective Deterrence? Assured prevention against any terrorist threat, including waterborne mining, is not possible. There is always more that one can do to provide greater security. At some point, one goes beyond the achievable in attempting to assure prevention, particularly in expense. Eventually, one reaches the point of diminishing returns. One could inspect every nook and cranny of every inbound ship, but the expense would be astronomical. And considering the “just-in-time” inventory model, the inspection expense would be miniscule compared to the cost to the U.S. economy. Effective deterrence would be the point at which reasonable cost reduces risk to an acceptable level. Unfortunately, there is no obvious point on a graph that will indicate when one has achieved proper balance of cost and risk. Nonetheless, a number of initiatives are being pursued.

Layered Defense. A “layered defense” approach to Maritime Security was suggested to Congress in a recent Congressional Research Service report. “The first security perimeter in this ‘defense in depth’ strategy would be at the overseas point of origin. Security experts argue that an effective solution must start with preventing undesirable items from entering the maritime transportation network, because if some of these items – particularly nuclear weapons or dirty bombs – reach a U.S. seaport, they could be detonated before inspectors could find them.”²¹

Container Security Initiative (CSI). The Container Security Initiative permits U.S. Customs and Border Patrol agents to inspect U.S. bound containers. Already operational at seventeen overseas ports,²² it is the outer ring of the “layered defense” concept. Development of electronic tamper-proof container seals²³ has been under discussion, also. It is doubtful that

terrorists would use shipping containers to move mines, but increased scrutiny at the point of origin would likely deter loading of mines there on large vessels.

International Port Security Program (IPSP). In June 2003, the U.S. Coast Guard began participating in the IPSP. This program helps ensure countries' compliance with International Ship and Port Facility Security Code through international teams that visit approximately forty-five countries per year and also have liaison officers stationed throughout the world's ports.²⁴ IPSP is important because it is the vehicle by which the U.S. Coast Guard actively participates in pushing the U.S. maritime defense perimeter outward to foreign shores. It enables the Container Security Initiative and allows formal action, with international acceptance, to take place against suspect vessels

Identification of Suspect Vessels. Through IPSP, suspect vessel identification allows enforcement actions to take place with countries not complying with international code. Specific enforcement actions include boarding a vessel at sea, prior to entry into port, and denying entry into U.S. waters.²⁵ "According to press reports, U.S. intelligence officials believe they have identified 15 cargo ships that have links to Al Qaeda."²⁶ Having a list of such suspect vessels could greatly reduce risk and the time required to clear a mine threat if combined with an existing system that keeps historical track information—discussed later in the paper's response section.

Maritime Safety and Security Teams (MSSTs), “MSSTs are a quick response force capable of rapid, nationwide deployment via air, ground or sea transportation in response to changing threat conditions and evolving Maritime Homeland Security (MHS) mission requirements.”²⁷ MSSTs each consist of seventy-five active-duty military personnel.²⁸ Currently, ten MSST teams are established throughout the United States, with three more to be established in 2005.²⁹ MSSTs have been trained in a wide variety of capabilities, including Antiterrorism/Force Protection (ATFP), non-compliant boarding, underwater port security, and WMD detection.³⁰ Underwater port security might imply that, if a specific threat were known, an MSST could provide deterrence to the deployment of a waterborne mine in the immediate port area.

Conclusion. Given that the events of 9-11 are still relatively fresh and that to acquire funds and establish programs requires considerable time, U.S. efforts have not yet had time to reach the point of diminishing returns. The United States is, however, doing just about everything it feasibly can to strengthen security of U.S. ports. There are a few additional steps, though, that could be taken with little or no further cost.

Effective Response

What is Effective Response? There are two factors to address in response—psychology and time. The aim of mining is psychological at its core. It is through psychological manipulation that the factor of time is lengthened, thereby causing the economic effect desired. “The psychological threat from a minefield arises from the inability to know with certainty the true threat and, second, from the risk of dire consequences if the threat is underrated. . . .The detonation of one mine [whether by accident of an innocent or through mine clearance operations] gives no assurance that the field is clear of danger and gives virtually no information about the presence of other mines. If anything it confirms the presence of a hidden threat.”³¹ Every interested party—nation and business—will individually determine what degree of risk it is willing to accept. That degree may be significantly less than the United States is willing to accept to get the economy going again. The point is, even though the United States may feel risk has been sufficiently reduced, other interested parties may not feel the same.

A tangible example of this is the recent Mad Cow Disease scare in the United States. Because there was more at stake for the United States, U.S. officials were far more willing to export U.S. beef than other nations were willing to import U.S. beef. There was simply less at stake for other nations since they could get their beef from elsewhere. So of primary importance is credibly assuring other parties that the threat has been removed or risk has been adequately reduced to their satisfaction.

Mine Clearance. There are two basic methods for clearing mines. One is through the use of towed sonar—called mine hunting. The sonar data collected are analyzed to locate mine-like

objects. The mine-like objects are then located by other assets, such as divers or remotely-operated vehicles, and either discounted—if not a mine—or neutralized. For sonar to be effective, the environment must be cooperative. Obviously, the less smooth or more cluttered the bottom, the more time will be required to search, find, and eliminate the threat. Sea bottoms can be so rough or cluttered that the mine hunting method is virtually ineffective. Using the previous Norfolk example, one would not need any particular knowledge of the bottom types to assume that, based on the high volume of recreational and commercial traffic in the Norfolk area, the bottom is littered extensively with debris. Combine that with the likely debris surrounding the tunnels that has been there since construction. As a result, mine hunting may not be very effective.

The other method is called mine sweeping. Basically, it involves towing specialized equipment through the water to influence the mine to detonate, thereby eliminating the threat in a somewhat controlled way—not a very attractive option in the vicinity of a major metropolitan tunnel.

Conclusion. Research did not illuminate any specific measures aimed at reducing the effects of terrorist mining of U.S. ports. Standard fleet readiness training keeps U.S. mine countermeasures (MCM) forces ready to conduct operations on call. That is not the issue. The issue is what tools and information would be provided to the MCM forces to allow quickest possible execution of a response.

In this case, considering the consequences, adequate preparations are not being made. The encouraging thing is that, *with some focus and adjustments*, there are measures already being taken that could bring U.S. response capability closer to adequate. In order to develop

an adequate response, though, there are also measures that should be taken that will have to be evaluated against the point of diminishing returns because they will take a considerable amount of money and time to establish.

Recommendations

In general, Commander, U.S. Northern Command (COMUSNORTHCOM) should take the lead on addressing the mine threat to U.S. ports, primarily because he would own the MCM forces conducting operations in response to this type of crisis. Additionally, he is in a position to prioritize, along with other governmental agency inputs, the importance of the mine threat in context with all other threats that are being addressed. Finally, from a military standpoint, he is in the position to speak directly to, and on an equal plane with, the CNO with regard to funding issues—something that has been, and will continue to be, a difficult matter of prioritization. The following are specific recommendations for USNORTHCOM.

Effective Deterrence Recommendations

Raise domestic agency awareness levels. Small mines could possibly be hidden in inconspicuous areas outside shipping containers, where they could be readily moved to the weather deck for deployment. The inspection process should be examined for possible vulnerabilities to dangerous cargo other than CBR-type weapons. At a minimum, agencies conducting inspections, specifically MSSTs, USCG, and Customs and Border Control, should be equipped to educate personnel on the existence and nature of the threat.

Include countermine procedures in the layered defense scheme. Because of the possibility of small vessel transfer to a ship on the high seas, mines can still be placed undetected on inbound vessels. And because mines should be detected before they reach territorial waters, random inspections should be pushed out to include the contiguous zone, or even the exclusive economic zone (EEZ). At a minimum, suspect vessels should receive this type of treatment. To satisfy international law requirements, the ship would likely need to be inbound to a U.S. port in order to justify inspection in the EEZ.

More frequent inspections pose economic problems when one considers the “just-in-time” inventory model. This would have to be taken into consideration when deciding how often to exercise these more thorough inspection standards to balance the benefits with the tradeoffs.

Intelligence. Some effort should be applied in the intelligence community as to where mines might be obtained most easily by terrorists. One specific example of intelligence collection would be the disposition of Iraq’s mine inventory. Did it “evaporate” as did other weapons such as small arms in the OIF aftermath? Or was the post-war effort focused enough to confiscate and destroy them, or place them in safe-keeping for the future government?

Effective Response Recommendations

Coast Guard Vessel Tracking System. The Maritime Transportation Security Act of 2002 states that, “The Secretary may develop and implement a long-range automated vessel tracking system for all vessels in United States waters.....The system shall be designed to provide the Secretary the capability of receiving information on vessel positions at interval positions appropriate to deter transportation security incidents.”³² What has resulted is the

Coast Guard Vessel Traffic System (CGVTS). As well as meeting the above requirements, “A minimum of twelve months’ vessel transit data is stored in an Oracle database for later reconstructing collisions, spills or other incidences. . . .”³³ Such data would be extremely important in MCM response operations by reducing the factor of space. Specifically, if suspect vessels were identified as possible mine delivery platforms, areas where mines might have been placed could be narrowed, thereby greatly reducing the scope of MCM operations and total response time. Currently there are six U.S. port areas online with this system—New York, Puget Sound, San Francisco, Los Angeles/Long Beach, Prince William Sound, and Houston/Galveston.³⁴

In a positive step, in March 2003, the CGVTS merged with the Department of Defense command and control system at the Joint C4ISR Battle Center (JBC),³⁵ under USNORTHCOM. Thus, effort could be applied to ensure that the data collected and stored are compatible with the Mine Warfare Environmental Decision Aids Library (MEDAL). MEDAL provides the MCM operational level picture through the Global Command and Control System (GCCS). Planning time could be saved if the data could be immediately imported into MEDAL.

Exercises. Joint Task Force Civil Support (JTF-CS), the deployable C2 element of USNORTHCOM, conducts exercises with civil authorities under varying scenarios. DETERMINED PROMISE 2004 is one example. While this is an excellent way to establish and hone response procedures, what is noticeably missing from the exercises is any mention of mines. Exercises could be the vehicle by which all the previously discussed issues could be incorporated and evaluated to produce a focused, results-driven response plan. Actual

mine removal operations would be almost exclusively a military operation, but close coordination with civil authorities would be required. Expectations of what MCM forces can do versus what MCM forces can actually do are commonly at odds. MCM operations can be painstakingly long to the surprise of people who have never worked with them. Regular exercises would allow the MCM experts to display current capabilities, spread awareness, and build realistic expectations, particularly with respect to timelines, throughout the national command structure. In particular, exercise participation could shed light on the effectiveness of the CGVTS and whether adjustments are necessary to achieve full advantage.

Bottom mapping. This is the single most effective area where effort spent beforehand can pay big dividends response time reduction. It is also a time-consuming and expensive measure. And admittedly, the database is perishable. The shelf-life has been under debate for some time in MCM circles. Local weather and volume of shipping traffic would be factors in determining shelf-life.

Having U.S. port data stored and ready for use would offer more options in a reaction plan. First, it could eliminate extremely rough or cluttered sea floor areas that would not be conducive to mine hunting. In other words, the MCM commander would already have an idea of how to prosecute the threat beforehand. Regardless of shelf-life, it could also lead, in some situations, to the establishment of alternate routes that would be easier to hunt—the new route requiring less time to clear than the previously established route. Second, on the routes that must be hunted in order to open them, the bottom mapping data could be used to conduct change-detect procedures, already being used in the MCM community. Targets previously discovered, as indicated by the database, can be quickly eliminated, allowing

MCM assets to focus on new targets. In some cases, this can significantly reduce clearance timelines.

If this were easy to do, it would have already been done. One obstacle to this would be the coordination of Inter-deployment Training Cycles (IDTC) and actual deployments with bottom mapping of ports of priority. Another obstacle would be funds to support bottom mapping operations, since they will almost never coincide with training cycles or deployments. Both obstacles would be best addressed by USNORTHCOM through coordination with the CNO for funding, and through coordination with the CNO and Commander Mine Warfare Command (COMINWARCOM) for the most effective ways to accomplish homeland security priorities without upsetting training and readiness cycles of MCM forces so they maintain their primary war fighting capabilities.

In Closing

Given that it is difficult for one to determine the likelihood of any type of terrorist attack, one must find some way to quantify, however loosely, the threat. It is pointless to ask an unanswerable question such as “will terrorists think of it?” An answerable question is “What if terrorists think of it?” The intention of the paper is to offer an answer to that question, or at least a starting point from which to work. The intention is not to leave the reader with some degree of certainty whether a terrorist waterborne mining incident will happen. Only that it would be a viable and effective course of action should they “think of it.”

NOTES

¹ MDA TEN and a portion of MDA SIX are still active as of this latest advisory. Of interest in the advisory text is this from paragraphs five and six: "Because areas previously mined can never be judged completely safe, even after successful demining operations, mariners are cautioned that mines still present a hazard. . . . This cancellation of previous MDAs, transit channel coordinates and mine swept areas does not guarantee the safe passage or the absence of mines, nor does it represent any assumption of liability by the U.S. Government for the safety of commercial traffic." Maritime Administration, MARAD Advisory No. 2001-01, Subj: Mine Danger Area Advisory For Merchant Shipping in the Northern Persian (Arabian) Gulf, 13 March 2001, <<http://www.marad.dot.gov/Headlines/advisories.html>> [28 January 2005].

² Tom Wicker, "Illusions Exploded In the Gulf," New York Times, 25 July 1987, sec. 1, p 31.

³ "The ability of sea mines to cause damage out of all proportion to their cost is well documented. Three examples of attacks on US Navy (USN) ships serve to reinforce this lesson. In 1988, the frigate Samuel B Roberts nearly sank after striking an Iranian SADAFA-02 contact mine. Two years later, during the 1990-91 Gulf War, the Aegis cruiser USS Princeton activated two of the approximately 1,300 mines laid by Iraqi forces during the conflict (including at least one SEI Manta bottom mine), and the amphibious assault ship USS Tripoli struck an LUGM-145 moored contact mine. The latter, carrying a 145kg warhead, tore a hole measuring 6x9m in the Tripoli's hull. These four weapons, with a total estimated procurement cost of US\$11,500, caused damage costing US\$117 million to repair - a return on investment of 10,000:1." Mark Hewish, "Sea mines, simple but effective," Jane's International Defence Review, 01 November 2000, <<http://idr.janes.com>> [10 January 2005].

⁴ Christopher Martin, Damn the Torpedoes! The Story of America's First Admiral: David Glasgow Farragut, (London: Abelard-Schuman, 1970), 258.

⁵ Geoffrey Till, "Can Small Navies Stay Afloat," Jane's Navy International, 01 August 2004, <<http://jni.janes.com/>> [10 January 2005].

⁶ Jane's Online, "Configuration and Operational Capabilities," Jane's Intelligence Review, Middle East, 01 September 2002, <<http://jir.janes.com/>> [10 January 2005].

⁷ Jane's Online, "NAVY, Iran," Jane's Sentinel Security Assessment - The Gulf States, 22 July 2004, <<http://sentinal.janes.com>> [10 January 2005].

⁸ Anthony H. Cordesman, "Iran's Developing Military Capabilities, Executive Summary," Center for Strategic and International Studies, 8 December 2004, 11, <<http://www.csis.org/burke/mb/>> [10 January 2005]. Note: It is a working draft.

⁹ John Pike, "Navy," Global Security.org, 09 August 2004, <<http://www.globalsecurity.org/military/world/iraq/navy.htm>> [10 January 2005].

¹⁰ John Frittelli, Port and Maritime Security: Background and Issues for Congress, (Washington, DC: Library of Congress, Congressional Research Service, 5 December 2004), 18.

¹¹ Anthony Watts, "Underwater Weapons - Mines, Italy," Jane's Underwater Warfare Systems, 19 August 2004, <<http://juws.janes.com/>> [10 January 2005].

¹² U.S. Coast Guard, "Maritime Safety and Security Teams," U.S. Coast Guard Fact File, <<http://www.uscg.mil/hq/g%2Dcp/comrel/factfile/factcards/msst.htm>> [25 January 2005].

¹³ Frittelli, 6.

¹⁴ U.S. Maritime Administration, "U.S. Waterborne Foreign Trade," Waterborne Databank, 01 October 2004, <http://www.marad.dot.gov/MARAD_statistics/> [25 January 2005].

¹⁵ Ibid.

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