Chapter Ten:
Naval And Amphibious Forces

While Seapower played a dominant role in enforcing the UN sanctions and embargo during Desert Shield, it played a largely supportive role in Desert Shield. In spite of the fact that the Coalition deployed more seapower during the Gulf War than had been deployed since World War II, the Gulf War involved few tests of the unique capabilities of seapower. In many areas, lessons are more the exception than the rule. Naval airpower played an important role in supporting the Coalition air campaign, but the unique capabilities of sea-based and amphibious air power were only exploited in missions against a weak Iraqi Navy. Sea control and the campaign against Iraqi naval forces presented only a limited challenge because the Iraqi Navy was so small, and the Coalition's amphibious capabilities were not used in combat. While the Gulf War demonstrated the importance of low cost systems like naval mines and countermine capabilities, the countermine campaign is difficult to analyze because Iraq was allowed to mine coastal waters without opposition during Desert Shield. Naval gunfire supported several Coalition land actions, but its value was never fully exploited because the Coalition had such a high degree of air supremacy, and Iraq was forced to retreat for other reasons.

This makes it difficult to draw broad lessons about the role of sea power in contingencies involving major surface actions, sea-air-missile encounters, and actual amphibious landings. at the same time, naval forces did illustrate As a result, the Gulf War's lessons apply more to the details of actual operations than broad doctrinal and operational issues.

There are, however, important lessons that can be drawn regarding rapid deployment, naval air, cruise missiles, naval gunfire, preparing for amphibious operations, and sealift. Naval operations illustrated the importance of sea control and the flexibility of naval power. They showed the importance of combined arms capabilities and jointness. They illustrated the value of carrier task forces, naval air power and long range strike capabilities, precision warfare, and night/all-weather capabilities. They also illustrated the importance of readiness, high training standards, and initiative.

The Role of Seapower in Deploying and Protection Coalition Forces

Chapter Two has shown that Seapower played a critical role in enforcing the UN sanctions and embargo during Desert Shield, and provided some of the first elements of US power projection capabilities to arrive on the scene. The two British and eight US naval

forces in the Gulf on August 2 were rapidly reinforced by the carrier battle group led by the USS *Independence* in the Indian Ocean, and by the carrier battle group led by the USS *Eisenhower* in the Eastern Mediterranean. Both carrier battle groups and their embarked air wings were placed under the control of USCENTCOM on August 7, which began the build-up of the largest naval task force since World War II.[1]

Maritime Prepositioning Ships (MPS) proved to be of particular value in supporting rapid power projection.[2] The first three MPS ships coming from Diego Garcia were ordered to leave for the Gulf on August 7, 1990 and arrived in a matter of days. The three 755 foot ships carried more cargo than would have been possible with 3,000 C-141 airlift flights. They not only carried military equipment and cargoes, but maintained the equipment, made it combat ready, and off-loaded in a stream that allowed rapid "marry up" with the Marine personnel arriving by air. It was the Maritime Prepositioning Ships that allowed the 16,500 Marines of the 7th Marine Expeditionary Brigade to fly into Saudi Arabia, marry up with all their combat equipment, and be combat capable by August 25, 1990.

Naval forces played a major role in deploying land forces. Sealift carried 95% of all the cargo used to equip and supply the US and European land forces. The US Navy deployed a total of 11 afloat prepositioned ships (APS) with ordnance, fuel, and supplies for the Army and Air Force plus one carrying a field hospital. A total of thirteen Maritime Prepositioning Ships (MPS) were eventually deployed from Diego Garcia, Guam and the Atlantic, and carried the unit equipment and supplies for three USMC expeditionary brigades and two hospital ships that were deployed to the area.

The Navy made extensive use of a force of eight SL-7 fast sealift ships and of 40 of the 96 ships in its Ready Reserve Force (RRF). About 75% of all US military cargoes were carried on this force. Only 4.4% of the cargo that they carried went to the US Navy forces in the Gulf. The US military Sealift Command (MSC) delivered more than 2,000 tanks, 2,200 armored vehicles, 1,000 helicopters, and hundreds of self propelled artillery weapons.[3]

At the peak of Desert Storm, the US deployed six carriers and a total of more than 165 ships.[4] Allied nations deployed more than 65 ships to Southwest Asia, including those in the Red Sea and Indian Ocean.[5] These forces included surface combatants from the Southern Gulf navies, Argentina, Australia, Canada, Denmark, France, Italy, the Netherlands, Norway, Spain, and the United Kingdom. The British, Kuwaiti, Spanish, Saudi, and US navies engaged in offensive anti-surface warfare against the Iraqi Navy. The Southern Gulf navies patrolled their coastal waters, and other Coalition navies provided fleet defense and protected logistic ships and carriers. For example, France placed one

frigate under US operational control on February 15 to provide escort missions for logistic ships, although it was not authorized to carry out offensive operations.[6]

Coalition naval forces were placed under the command of USNAVCENT as the Coalition naval commander, and performed a number of combat roles in addition to maintaining sea control , attacking Iraqi naval forces, and supporting the countermine campaign. As has been discussed in Chapter Seven, naval forces launched cruise missiles in support of the air campaign and strategic bombing. They played a major role in both the defensive and offensive air campaign. They, provided naval gunfire support, and an amphibious capability that played a major role in tying substantial amounts of Iraqi land forces to coastal defense positions, and also provided a contingency capability to seize a line of communication into Kuwait.

The Role of Naval Airpower in the Air Campaign

Although the Coalition did not need to rely on the unique capabilities of sea-based air forces during Desert Storm, Chapters Six and Seven have shown that it relied heavily on carriers and on naval air forces. The US Navy initially deployed three carriers with a total of 60 F-14s, 60 F/A-18s, 45 A-6Es, 15 EA-6Bs, and 30 S-3s, for a total of 210 aircraft. By Desert Storm, it had deployed a total of six carriers with 100 F-14s, 10 F/A-18s, 95 A-6Es, 24 A-7Es, 26 EA-6Bs, and 50 S-3s, for a total of 395 aircraft. The USMC air wing had 72 F/A-18s, 60 AV-8Bs, 20 A-6Es, 15 EA-6Bs, 24 OV-10s, and 24 KC-130s for a total of 215 aircraft. The Marines also had 325 helicopters, including 50 AH-1Ws, 25 AH-1Js, 50 UH-1s, 120 CH-46s, and 80 CH-53s.[7]

The US Navy and USMC each flew more sorties than the two largest allied air forces combined, and they flew a total of nearly 30% of all US sorties and 25% of all Coalition sorties. As Table 10.1 shows, US Navy aircraft flew a total of 18,303 sorties by the time Desert Storm ended, or 18% of all US sorties flown, and 16% of all sorties flown during the Gulf War. US Marine Corps aircraft flew a total of 10,683 sorties during Desert Storm or 11% of all US sorties flown, and 9% of all sorties flown during the Gulf War.[8]

Table 10.1

The Impact of US Navy and Marine Corps Forces on the Air Campaign

Major Combat Missions

Country	Strike Attack									
	Interdiction			Air Support			Counter-Air		TOTAL	
	Interdiction	Battlefield	Total	CAS	FAC	Total	Defensive	Offensive	Total	
US										
Navy	5,060	0	5,060	21	0	21	4,245	1,936	6,181	11,262
Marine Corps	4,015	249	4,264	2,937	1,019	3,956	0	757	757	8,977
Total Naval	9,075	249	9,324	2,958	1,019	3,977	4,245	1693	6,938	20,239
Total US	32,863	785	33,648	4,427	1,701	6,128	8,803	9,115	17,918	57,693
Total Coalition	36,717	1,560	38,277	4,427	1,701	6,128	13,075	10,670	23,745	68,149

Electronic Warfare and C3 Missions

	Reconnaissance				C3				Electronic Warfare			
	Recce	SLAR	Observ.	Total	ABCCC	Early Warning	C3	Total	ECM	ESM	EW	Total
US												
Navy	1,190	0	241	1,431	1,143	0	0	1,143	5	260	0	265
Marine Corps	3	0	0	3	157	0	0	157	0	17	326	343
Total Naval	1,193	0	241	1,431	1,300	0	0	1,300	5	277	326	608
Total US	2,064	147	683	2,894	1,501	379	24	1,904	11	1,014	1,813	2,838
Total Coalition	2,406	147	683	3,236	1,501	464	24	1,989	11	1,094	1,813	2,918

Refueling and Support Missions

	Refueling									
	Refueling	Tanker	Total	Airlift	Special Forces	Support	Training CAP	Surface	Other TOTAL	GRAND
US										
Navy	0	2,782	2,782	0	3	41	262	198	916	18,303
Marine Corps	453	8	461	9	1	714	14	0	4	10,683
Total Naval	453	2,790	3,243	9	4	755	276	198	920	28,986
Total US	11,533	2,790	14,323	17,657	946	1,022	526	198	1368	101,370
Total Coalition	13,105	2,790	15,895	22,064	948	1,071	686	238	1,466	117,838

Note: The data cover the period from January 16, 1991 to February 28, 1991. There are significant national differences in definition, and some countries do not report special forces and support sorties. ABCCC = airborne battlefield command and control center. ECM = electronic countermeasures. ESM = electronic support measures or intelligence. C3 = command, control, and communications. CAP = combat air patrol SLAR = side looking airborne radar.

Source: Adapted by the author from the data in Cohen, Dr. Eliot A, Director, Gulf War Air Power Survey, Volume V, Washington, US Air Force/Government Printing Office, 1993. The data are generally selected from the tables on pages 232-233, although some data and categories are modified to reflect different data in pages 235-386.

The Strengths and Weaknesses of Naval Air Power

US Navy carrier aircraft flew 288 sorties on the first day of Desert Storm. Carrier aircraft played a major role in providing air cover for naval and amphibious forces, and the southern Gulf states, and delivered 80% of the HARM missiles fired in Desert Storm.[9] They performed a large number of the electronic warfare missions for the Coalition, and EA-6Bs played a major role in providing electronic warfare escorts for the strategic bombing effort. While data bases differ on the details of sortie rates and allocations by mission, 199 of the 444 US Navy combat aircraft operating from US carriers were strike-attack aircraft that flew about 30-35% of the power projection missions during the Gulf War, a figure which is roughly proportionate to the number of these aircraft as a percent of the total force.[10]

USMC air forces normally acted as land-based forces flying out of fully supported air bases, rather than as amphibious expeditionary forces. Only 26 USMC AV-8Bs operated from carriers during the Gulf War, and some of these deployed to land once the ground campaign began. USMC aircraft did, however, amount to roughly 17% of the total tactical aircraft deployed that could deliver air-to-ground ordnance, and they flew a very high number of the actual strike/attack sorties -- close to 40%.[11] Many were forward-based on poor or unimproved airfields, and this basing posture allowed them to maintain a high sorties rate and reach an exceptionally high amount of total ordnance drooped per aircraft. The Marines also demonstrated the value of a V/STOL aircraft like the AV-8B, confirming the lessons of the Falklands conflict.

The total contribution of US Navy and US Marine Corps forces in terms of the number and types of offensive weapons delivered is shown in Table 10.2, and it is obvious that naval aircraft played a major role in supporting the land campaign. Both US Navy and US Marine air operations aircraft did, however, reveal a number of problems which are already leading to significant changes in each service:[12]

- *US Navy and USMC air warfare planning and training had focused on small to mid-sized operations that emphasized action that was independent from US Army and Air Forces.* The US Navy had emphasized a "forward strategy" based on attacking the Soviet Union. It had not adequately trained or organized to support amphibious operations in major regional conflicts, and it had allowed itself to become decoupled from the emphasis that the US Army and Air Force placed on

many aspects of jointness in the AirLand battle. This experience has helped lead the US Navy to shift from a maritime strategy centered around a unilateral conflict with Soviet naval forces to power projection and jointness, and to a new emphasis on cooperation with the USMC in emphasizing amphibious operations.[13]

o This pre-Gulf War focus on maritime strategy and small contingency operations (CONOPS) meant that Navy and Marine air units required changes in C4I/BM and training for a large AirLand campaign, and shifts in tactics, aircraft equipment, and munitions. Navy and Marine air forces now receive far more training in joint warfare.

o The US Navy and US Air Force had allowed their forces to evolve with different C4I/BM systems and equipment. The US Navy was not organized or trained in integrated JFACC operations with the USAF, could not fully exchange secure data with the USAF on a real time basis in using the ATO, and often faced the problem that its communications systems were limited to 64 and 75 baud when it needed 2,400, 4800, and 9600 baud.[14] In a war dominated by land-based air power, this limited the flexibility of carrier air power -- although just the opposite situation might have occurred if the air war had begun in August, when carrier air power was dominant. As has been described earlier, these C4I/BM problems have led to major changes in the US Navy's C4 system, and in its emphasis on joint operation of the JFACC and ATO system.

o US Navy carriers and command ships needed improvements to their C4I/BM to handle high intensity strike operations against land forces. They had not been adequately designed and modernized to meet the needs of high intensity operations like Desert Storm.[15] For example, the Navy concluded after the war that it needed a computerized system to assist in ATO and air mission planning similar to the three USAF Computer Assisted Force Management Systems (CAFMS) used to support the JFACC. The CAFMS included a central computer and 20 terminals and could handle very high volumes of planning information. In contrast, the US Navy lacked the software and communications to deal with the flood of data that it was receiving. It ordered CAFMS terminals for its carriers after the war to make them fully interoperable in using ATO data from the Air Force, and began to upgrade many aspects of its Tactical Environmental System, Naval Intelligence Processing System, radars, computers, and identification systems.[16]

o The US Navy was not fully prepared for coalition warfare in which allied ships played a limited role in protecting US ships and carriers. The US had grave defects in mine countermeasure capabilities that will be described shortly, although these

defects had little impact on carrier operations. More significantly, only Western ships could communicate using the Link 11 network, and it rapidly became apparent that effective UHF satellite multiple subscriber access systems were needed. The US provided the AN/USC-43(v) advanced narrow-band digital voice terminal equipment to deal with these problems. The UK furnished "Brahms", a system for providing secure speech capability over commercial satellites. The US also introduced Have Quick II frequency hopping radios, and improvements were make to US and British IFF systems to reduce the risk of friendly fire. What could not be fully addressed was providing integrated C^4I/BM capability for the US Navy to operate in full cooperation with advanced allied navies to cooperate in activities like mine countermeasures, anti-ship missile defense, targeting, etc.[17]

o The US Navy F-14s had interoperability problems with the USAF F-15Cs. The F-14 units were not trained or equipped with compatible equipment to allow them to cooperate with the USAF in beyond visual air combat in a dense air combat environment.

o The Navy experienced deployment problems with its carriers, and range problems with its aircraft. The Navy was very reluctant to deploy carriers forward into the Gulf, and they had to be kept out of the range of Iraqi missiles, aircraft, and mines. This presented range problems for naval aircraft, since carriers in the Gulf were still 500 NM miles from many Iraqi strategic targets, as were operations from carriers in the Red Sea, which were 650 NM from such targets. It can be argued that these problems were often contingency specific, but it became clear that US Navy aircraft like the F/A-18C/Ds were often range-payload limited even with external fuel, and that both the F/A-18s and A-6s had to place heavy reliance on USAF tankers for refueling. Rear Admiral Jim A. Lair, Director of the US Navy's Tactical Readiness Division, recognized this lesson shortly after Desert Storm, and stated, "The F-15E Strike Eagle emerged as a super platform and the F-117A did very well. Our future naval aircraft will have to be a multirole aircraft like the F-15E, and we need to have some sort of stealth aircraft as a follow-on to the A-12."[18]

o The Navy experienced serious problems in its development of long range strike aircraft. The US Navy had canceled programs to produce an upgraded version of the A-6 long before the Gulf War to help fund development of a new stealth attack fighter called the A-12. Since the Gulf War, the Navy has decided not to procure a stealth strike aircraft, or any aircraft with the range of the A-12 -- which had a nominal unrefueled strike radius of 700 NM. It also intends to withdraw its A-6s from service by 199, although these are long range strike aircraft which have a

mission radius of 390 NM unrefueled, and a mission radius of 696 miles with external fuel. Its F-18C/Ds have mission radiuses as short as 160 NM with internal fuel and 375 NM with external fuel. The Navy's answer is to buy the F-18E/F with about twice the mission radius of the F-18C/D, and provide attack capabilities for the F-14D, which would have a strike radius of 470-580 NM.[19] It is far from clear that this mix of aircraft will give Navy carrier aircraft the future range-payload and lethality needed for a major regional conflict against an air force that is properly trained and equipped to use advanced fighters like the MiG-29, Mirage 2000, or their successors.[20] The cruise missile and SLAM may be partial substitutes for long-range strike air power, but this is questionable unless cruise missile targeting and lethality experience major changes. Currently programmed changes such as adding a hard target penetrator warhead, improved mission planning, and a possible imaging seeker to the cruise missile may help, but cannot replace long range strike aircraft.[21]

o Like all of the Coalition air forces, including the USAF, the US Navy and USMC aircraft lacked adequate precision strike and night/all-weather aircraft capability. As Table 10.2 shows, the Navy underestimated the need for laser designators and laser-guided bombs, and smart ordnance capable of supporting stand-off precision attacks.[22] This is a major lesson of the war and one the US has acted on. As has been discussed in Chapter Seven, the US Navy and USMC aircraft already have three to four times the precision strike capability they had during the Gulf War. The Navy is also buying the F/A-18E/F and providing the F-14 with an air-to-ground capability, and the Marine Corps plans further major upgrades in its F-18s and AV-8Bs. The two services are procuring advanced precision weapons like the JDAM, JSOW, SLAM P3I, TLAM BIP, TSSAM, and Harm Block IV.[23]

o The Navy had significant problems in performing adequate land reconnaissance and battle damage assessment. The Navy had 17 F-14s, equipped with the tactical-air reconnaissance pod (TARP), which played a major role in acquiring battle damage data during the war, but these system had important limitations. The TARP is 12 feet long and weighs 1,700 pounds. It contains two cameras and an infrared sensor. The system consists of one KS-87 frame camera, one KA-99 panoramic camera, and one ADD/5 infrared system. On some missions, the KA-99 was replaced with the long range KA-153 frame camera, which provides high resolution over a viewing field that stretches from 10-15 miles. The TARP system is suited for day-time good-weather damage assessment, but has no downlink, and film must be developed and returned to base. This limitation severely reduced the ability of the F-14 with TARPs to provide near real-time reconnaissance data.[24] The fact that

reconnaissance platforms that must return for processing are outdated, and that modern warfare requires real time secure data links is a lesson of the war.

o Although US Navy and USMC used F/A-18Ds and UAVs for reconnaissance and targeting with considerable success, neither service had properly organized, trained, or equipped its air units for intelligence collection and reconnaissance in support of extensive operations against armored and artillery forces, or for effective battle damage assessment.[25] Neither had an effective means of transmitting and receiving joint imagery data.[26] These problems, however, were defects that the US Navy shared with the USAF, USMC, and every other Coalition air force. (see Chapter Six). US Navy and USMC air units also received the same lack of effective intelligence support from US national intelligence agencies as the USAF, US Army, and USMC land units.[27] The US Navy and USMC concluded that there was a need for major improvements in these areas as a lesson of the Gulf War, and has already developed a new C4I, surveillance, electromagnetic warfare, and command and control warfare (C2W) architecture to try to correct these problems.[28]

Table 10.2

Weapons Delivered by US Navy and USMC Aircraft and Ships During Desert Storm

Precision Weapons			Unguided Weapons		
Type	Number	%	Type	Number	%
Harm	895	47	Mark 82	17,730	30
Laser Guided Bomb	880	46	Mark 83	18,619	31
Walleye	133	7	Mark 84	1,962	3
SLAM	7	-	Rockeye/APAM	21,746	36
	1,915	100		60,057	100
Tactical Air Launched Decoys (TALD)	137		Grand Total Air	61,972	
Tomahawk Cruise Missiles (TLAM)	282		Precision as a % of Total	97%	
			Unguided as a % of Total	3%	

Source: Adapted by the author from data in The Shield and the Storm: Naval and Marine Corps Aviation in the Gulf War, Association of Naval Aviation, Falls Church, Virginia, 1991, pp. 30-31.

The Importance of Air Defense Operations By Naval Air

Iraq never had the time or capability to challenge Coalition combat air patrols over the Gulf, and the relative air combat capability of the F-14 and other aircraft in providing counter air capabilities over the Gulf was never tested in combat. The only Iraqi air attacks that challenged the air defense effort over the Gulf occurred on January 24, when two Iraqi

Mirage F-1s attempted to attack the Saudi oil facility and port at Ad Dammam. An E-3A directed four Saudi F-15Cs to intercept the Iraqi aircraft long before they reached their target, and a Saudi pilot shot down both aircraft.[29]

Carrier-based combat air patrols did, however, provide a key part of the air defenses for the Southern Gulf states and the Coalition air forces in the Gulf, and this naval air effort was supported by surface vessels. During Desert Storm, the forces in the Gulf included a total of four aircraft carriers, and 21 other surface combatants -- six Aegis and three NTU cruisers, and 12 Australian, British, Italian, Spanish, and US destroyers and frigates.

Carrier-based combat air patrols had to be maintained continuously throughout the war. While Iraqi Air Force anti-ship capabilities were limited, the short distances in the Gulf precluded long range warning and the use of layered air and SAM defenses. Iraq had 32 Mirage F-1s capable of firing two Exocets each, four B-6D long range bombers with air-to-surface Silkworm missiles, 25 Su-24s capable of firing AS-7, AS-9, and AS-14 missiles, and Super Frelon helicopters that could fire two Exocets. Accordingly, about 21% of all the 18,303 sorties flown by US carrier-based aircraft during the Gulf War were air defense sorties. F-14s flew 67% of these sorties, and F/A-18s flew 33%. Canadian CF-18s supported this mission by covering one of the Persian Gulf combat air patrol zones throughout the war.[30]

There have been charges since the war that US carrier fighters did little more than protect the carriers, and debates over exactly how many sorties were flown in to protect US naval forces versus other areas. The data in Table 10.1 do not firmly resolve this issue, but they do make it clear that naval air flew a maximum of 4,245 defensive sorties over all areas, or about 23% of all sorties flown. Aircraft like the F/A-18, A-6, and EA-6 allocated virtually all of their sorties to the support of offensive operations or air defense of other forces.[31]

Naval counter air operations over the Gulf were also an important part of the overall air defense effort. The F-14 aircraft may not have been involved in significant air-to-air combat, but they provided air defense for the carriers aircraft were part of an overall Coalition air defense effort that maintained air surveillance over the Gulf, the Gulf of Oman, and the Arabian Sea. F-14s and E-2Cs detected, identified, intercepted and engaged or escorted all hostile or unknown aircraft entering the surveillance area. They provided air combat protection for Coalition forces operating in the area, and they helped provide air control and deconfliction for the Coalition aircraft operating over the Gulf. F-14s were also used in the TARPs missions discussed earlier, to provide air cover and escorts for USN and USAF aircraft in land attack missions, to support strikes during the Scud Hunt, and provide strike support in the form of both sweeps and combat air patrols.[32]

As has been discussed in Chapter Six, active air defense is a vital aspect of air operations, and one might as well accuse other Coalition air forces of wasting massive numbers of sorties to protect an empty desert or accuse the US Navy of wasting sorties to protect the sea. Neither accusation is a valid lesson of the Gulf War, but the value of improved economy of force is a different matter. Procuring the F-18E/F, and upgrading the F-14D with a strike/attack capability, will provide dual capability and allow resources to be shifted more effectively between the air offense and air defense missions. At the same time, it will present problems in terms of giving naval air a strike/attack capability suited to deep strikes against defended targets .

The Role of Surface Ships and Land-Based Aircraft in Air Defense, Reconnaissance, and Intelligence

Surface based ships played a major role in controlling air operations over the Gulf. Two ships -- the *USS Bunker Hill* and the *USS Worden* -- alternated as commander of the anti-air warfare mission. The *Bunker Hill* helped control part of more than 65,000 combat sorties with no accidents or engagements between friendly forces. The *Worden* deconflicted some 15,000 sorties returning from missions. This involved the operation of 17 different types of US aircraft plus aircraft from six allied nations. At the same time, Bunker Hill and Worden coordinated data from the radar pickets and other collectors in the Gulf, and shared data with the E-3A AWACS. The US established high frequency radio data link for sharing anti-air warfare data between all Coalition forces in the Gulf and a theater-wide data link to the AWACS and Coalition air defense ground stations.

US Navy E-2C all-weather carrier-based airborne warning and command and control aircraft also played a role in air C^4I/BM. At least one E-2C was in the air continuously during both Desert Shield and Desert Storm. The E-2Cs functioned well, although their radar range was limited by land clutter and weather effects.[33] In addition, the US Navy flew land-based P-3C Orions in maritime patrol missions in a joint effort with British Nimrods and French Atlantiques. P-3Cs played a major role in intercepts during Desert Shield, and flew 65 hours of fleet support per day during Desert Storm. They helped control naval attack aircraft, and used their APS-137 synthetic aperture radars both to acquire and identify long range naval and air targets. Land-based EP-3E intelligence/reconnaissance aircraft flew missions from Bahrain and Turkey.[34]

Lessons About the Future of Naval Air

The most important lessons the Gulf War teaches about naval air forces are not related to the details of naval air operations, but rather to the broader issues affecting air power that have been discussed in Chapters Six and Seven. When the strategic focus of sea power changes from sea control to the support of the AirLand battle, as it has with the end

of the Cold War, the test for naval air power becomes its ability to defeat land-based enemy air power, to carry out strategic and interdiction bombing, to support the AirLand battle, and perform related reconnaissance, BDA, and intelligence missions.

Seen from this perspective, both US Navy and USMC airpower had two significant defects during the Gulf War. They were not fully interoperable with the US Army and US Air Force in conducting the AirLand battle, and they were not organized at the start of the war to support mid to high intensity combat, in strikes outside littoral or coastline areas. Both of these weaknesses are important lessons of the Gulf War.

The US Navy and USMC have clearly learned the first lesson. Since the Gulf War, they have modified their C^4I/BM and training methods to become far more interoperable with the US Army and US Air Force, to prepare for the transition from initial power projection by sea (where the Navy may manage the JFACC and ATO process) and for major reinforcement by land-based air power (where the USAF may be the manager).

It is less clear that the US Navy and USMC have learned the second lesson. The US Navy has been constrained by resources, and by its own major program failures. Its mishandling and cancellation of the A-12 and A-X programs means that it will not have an advanced long-range all-weather precision strike/attack aircraft to replace the A-6 until well after the year 2010. At a time when the Gulf War shows that the battlefield is expanding in depth, and that Third World nations are acquiring more lethal anti-ship missiles, it is becoming dependent on the F/A-18E/F -- a follow-on version of the F/A-18C/D, and as yet unspecified programs to provide a limited attack capability to the F-14. If is far from clear that this program will give the Navy the "deep strike" capability that it needs to carry out highly effective interdiction and strategic missions in major regional conflicts and it has no technical or tactical justification. It is a program that events have forced upon the Navy through its own mismanagement.

The situation with the US Marine Corps is different. As Chapter Seven has discussed, the Marine Corps is making modifications to the key aircraft in its Air Wings that are logical extensions of the lessons of the Gulf War, and which are similar to those that the USAF is making in its aircraft. The Marine Corps has, however, chosen to keep its ground forces light and limited in sustained land warfare capability in order to maintain a force of three Marine Expeditionary Forces during a period of declining US defense expenditures.

The Marine Corps did obtain the transfer of additional tanks from the US Army in 1994, at the expense of the Army Reserve and National Guard. This still, however, leaves the Marine Corps heavily dependent on the US Army for armor and artillery reinforcements if it should become involved in mid to high intensity warfare. The Gulf War indicates that

such plans could place the Marine Corps in a conflict where there would not be time for the Army to reinforce, and where Marine air power would have to try to compensate for the land of tanks, M-2-like fighting vehicles, and artillery strength in Marine forces. It is far from clear that the planned configuration of Marine air wings will meet such a need, and the Marine Corps might either need the ability to massively reinforce the wing that it sends to support a given division, or obtain such support from the USAF. If the Navy's mismatch is one in long-range strike power, the Marine mismatch is one in the ratio of land to air power.

Naval Missile Strike Capabilities

As Chapter Seven has discussed, the US Navy introduced two new long-range sea-to-land missiles during the Gulf War that offer a potential solution to some of its long range air strike problems: The Tomahawk or TLAM, and the Standoff Land Attack Missile or SLAM. US Navy forces launched a total of 282 Tomahawk cruise missiles from two battleships, nine cruisers, five destroyers, and two nuclear submarines.[35] They launched 100 of these missiles in the initial barrage on Iraq, and a total of 216 by the end of the second day.

Both the TLAM and SLAM exhibited problems during these strikes, but both systems showed that naval forces could use missiles to attack land targets at long ranges, and with high survivability and stealth. The Tomahawk, in particular, proved that it could provide a platform capable of striking deep into the territory of hostile powers, without risking a pilot or requiring complex strike packages of aircraft, and could hit targets with a comparatively limited risk of inflicting serious collateral damage.

The Tomahawk

There are several versions of the BGM-109 Tomahawk, or TLAM missile, including a ship attack missile with homing features to attack fast maneuvering ships, and a nuclear version that can strike against land targets at ranges up to 1,500 miles. The version used in the Gulf War was the land attack missile, which is launched by surface ships and submarines.

This version of the Tomahawk has a 1,000 pound warhead, a range of approximately 700 nautical miles (possibly 805 miles in the Block II version), and a weight of 3,200 pounds. It is 20.5 feet long, has a 21 inch diameter, and a wing span of 8.58 feet. Its speed is in the high subsonic range -- Mach 0.5 to 0.75. It uses an air breathing turbofan engine, with an attached solid propellant booster. The booster launches the missile until the turbofan takes over for the cruise portion of flight when the weapon reaches altitudes of 100-300 feet. The missile can then fly at a high or low altitude approach to the point where

it begins to fly using terrain following guidance. The high altitude approach increases range, but also increases the possibility of radar detection.[36]

The land attack version of the Tomahawk uses two guidance systems to navigate by comparing stored digital ground images with actual ground points along its flight path. Its overland route is mapped out before the mission by theater planners using data from the Defense Mapping Agency. Programming the missile's flight from ship-to-shore is done aboard ship. Primary guidance is then provided by a terrain-contour-matching system (TERCOM) -- which is the only guidance system in the nuclear armed version. The TERCOM compares a stored map reference with the actual terrain to determine the missile's position, and then provides course corrections. TERCOM does this by using a radar altimeter to produce terrain profiles at preselected points along the route. These profiles are compared with the reference maps in the guidance computer to determine if flight corrections are needed. Each TERCOM update increases the precision of the missile's flight.

Conventional strikes of the kind made during the Gulf War, however, require more precise guidance than nuclear strikes. This guidance is provided by the addition of a digitized scene matching area correlation (DSMAC) system. The DSMAC system produces digital scenes of natural and man-made terrain features, compares these data on the ground below the missile with digitized data in its memory, and directs suitable course corrections.

The DSMAC seems to have given the versions of the Tomahawk, deployed in the Gulf War, a true total mission CEP of around 18 meters, although 10 meters is sometimes claimed. The DSMAC does, however, have a number of important limitations. It does not look forward to "see" its target or home in on it; it instead detonates at a preset time after it detects its last way point. It requires a relatively high contrast target for reliable flight, and uses a strobe at night to illuminate the ground for comparisons with its optical memory. Smoke, night, and unexpected changes in ground contrast, from causes like snow or flooding, can affect its performance.[37]

The Tomahawk has a small radar cross section and emits little infrared heat from its engine. If the missile functions perfectly and is properly programmed, it can function in most weather, and in any visibility conditions. It can do so only limited chance of detection or shoot down, and low collateral damage. While it can be detected from above by aircraft Doppler radars, the radar cross section of the TLAM or USAF CALCM are so small that they cannot be tracked at low attitudes by active and semi-active radar guided missiles. The Tomahawks can also fly under the radar coverage of most air defense, surface-to-air missile, and radar-guided anti-aircraft systems.[38]

Three types of Tomahawk conventional attack warheads were used during Desert Storm. The C model had a unitary 1,000 pound Bullpup unitary high explosive blast and fragmentation warhead. The C model can attack a target in three ways: flying straight into the target, detonating above the target, and or diving down to the target. It can destroy lightly hardened targets. The D model has a cluster warhead containing 166 BLU-97/B combined effects bomblets in 24 packages which can be dispensed to attack multiple targets. These bomblets weigh about 3.4 pounds each and are roughly the size of a soft drink can.[39] A third variant is reported to have been packed with long strands of carbon fiber which were used to short out the power transformers and lines at key air defense and other command and control facilities.

The UN Navy used Tomahawk to attack a variety of targets during the war. These targets included command and control targets, chemical and nuclear weapons facilities, surface-to-air missile sites, and low frequency radar sites of the kind with the best detection capabilities against the F-117A, command and control centers, and Saddam Hussein's presidential palace.

Most of the cruise missile strikes during the war took place during the first two days, when Iraq still retained significant air defense capability. The cruise missile offered a means of hitting key targets without risking a pilot. The Navy fired nearly 100 Tomahawks during the initial hours Desert Storm, beginning with a firing by the Aegis cruiser *San Jacinto* on January 17, 1991.[40] The *USS Wisconsin* served as the cruise missile strike director for the Gulf, firing 24 missiles in the first two days of Desert Storm. The two submarines launched six missiles and a single surface ship -- the destroyer *USS Fife*, launched 58 missiles.[41]

By the time the first 24 hours of the war were over, the US Navy and the USAF had used a total of 137 TLAMs and CALCMs. A total of 24 missiles were aimed at leadership targets, and 54 missiles attacked strategic targets like chemical and oil facilities. A total of 42 missiles were used to attack power generation facilities, many directly associated with tactical capabilities like air defense command and control, and 17 missiles attacked command and control facilities with immediate tactical value. A total of 79% of the night firings of cruise missiles took place during the first 24 hours of the war. By the second 24 hours of the war, missions began to change. The USAF did not fire additional CALCMs, and all Tomahawk strikes were during daylight. They included strikes on leadership facilities, oil, electric power facilities, oil facilities, and air defense facilities. Restrikes had already begun against electric power facilities.[42] The Navy had fired a total of 216 missiles by the end of the second day, or nearly 25% of its total inventory.[43]

As Table 10.3 shows, the US Navy used -- or attempted to use -- a total of 288-298 Tomahawks by the end of the war. A total of 282 missiles were actually launched, attained cruise flight, and proceeded towards their targets. Out of this total, 226 were timed for daylight impact, and 56 were timed to hit at night.[44] This emphasis on daytime strikes allowed the Coalition to continuously attack well-defended targets by using the cruise missile during the day and the F-117A at night. The US Navy also used the missiles equipped with carbon-fiber warheads to try to disable Iraqi electric power plants, and blind Iraqi command and air defense facilities early in the war. These weapons showered outdoor and switching areas with long rolls of fine carbon fibers to create massive short circuits, and some reports indicate they temporarily shut down critical facilities.[45]

As has been noted in Chapter Seven, it is clear that the Navy successfully launched 282 out of 288 missiles, 64% of which were launched during the first 48 hours. This was a 92% successful launch rate. The Tomahawk was the only Coalition weapon that could strike Baghdad in daytime without risking a pilot and air plane.[46]

The US Navy initially claimed that 85% of the missiles hit their targets, but this claim later proved to be grossly exaggerated, and said nothing about whether a "hit" produced a "kill," or caused significant damage.[47] Later studies of the Tomahawk by groups like the Center for Naval Analysis found after the war, however, that the TLAM had a far lower success rate for the system than the Navy first claimed. These studies have never been released, but interviews indicate that it found that about 50% of the TLAMs fired during the Gulf War hit within 10-18 meters of their target, and about 7-15% probably inflicted meaningful damage on the target.[48] The Department of Defense study of the war notes that problems occurred with the TERCOM mapping data and the quality of the target imagery, and that the weapons available for use in the Gulf War were Block II weapons, although the need for a Block III upgrade had already been recognized and was scheduled for deployment in 1993.

The study notes that,[49]

> "An assessment of the TLAM's effectiveness -- its success in reaching and damaging the intended target -- is much more difficult to determine because of incomplete battle damage assessment data and the inability to distinguish missile damage from damage caused by other assets, including other Tomahawks...Tomahawk was sometimes used to disrupt functions in a target facility, rather than damage the facility."

There were other problems in the way the Tomahawk was employed. At least three missiles were used against radar sites where they had little prospect of doing critical damage because their warheads lacked the necessary lethality over wide areas.[50] However,

many cruise missiles were directed at targets where they were not employed in sufficient numbers to produce decisive damage, and some later turned out to have been directed at targets of little military effectiveness.

Even when missiles hit hardened or semi-hardened targets accurately enough to produce some damage, the damage was sometimes superficial and of little military value. As is discussed in Chapter Eleven, the missiles directed against chemical warfare plants and facilities had little impact on Iraqi war fighting capabilities, even if they hit and severely damaged their targets, and 13 missiles were wasted in an effort to suppress Scud launch activity while direct air strikes could be organized. All carried out pointless attacks on Scud launch facilities that had no missiles and which had already been attacked by other systems.[51]

These problems have led to a great deal of revisionist criticism since the war, particularly after some highly publicized failures in cruise missile strikes against Iraqi targets following the Gulf War. In January, 1993, the US fired a total of 45 missiles -- 44 of which hit in the target area -- against an Iraqi "nuclear" target that had already been stripped of most of its nuclear capabilities -- and they still did not totally destroy the target.

The US fired 24 missiles at Iraq's intelligence headquarters in Baghdad on June 27, 1993.[52] This attack hit a building worth less than one 15th of the cost of the cruise missiles used to destroy it, and the resulting publicity disclosed a great deal more about the real world performance of Tomahawk than in previous strikes. A total of 16 missiles hit their aim points, if accuracy is defined as within 20 meters. Three hit somewhere else in the compound, one missile strike was ambiguous, and one could not launch because of navigational problems. Three of the missiles missed, hit Iraqi civilian buildings, and produced enough collateral damage to arouse a considerable anti-American sentiment in Iraq, but did nothing to interfere with Iraqi intelligence. Further, Baghdad announced that the headquarters had been fully rebuilt on November 16, 1993.[53]

The Tomahawk does, however, have great growth potential. The Block III improvements of the Tomahawk improve its weapons control system, theater mission planning system, and the all-up-round (AUR). It involves launch software upgrades and the use of GPS to increase accuracy within its existing CEP to levels close to 10 meters. It provides time of arrival software to allow precise timing of missile and air strikes, updates the DSMAC to cover a greater area and provide more reliable and robust correlation, improves the engine, and the submunition dispenser, and extends range using a new lighter, insensitive 650-700 pound titanium-encased warhead with greater explosive power. The use of GPS will also greatly increase flexibility in the missile's attack profiles and ability to attack directly from the see or in low land-contrast areas.[54]

A Block IV program for the period near the year 2000 may provide a wide range of additional improvements, including faster retargeting, better and more flexible fusing, and better salvo launch planning. Current options include a new mission computer, a computerized heat detection system to allow the missile to recognize the target at night or if obscured by smoke, a data link to communicate to the launch ship whether the missile is likely to hit the target, and a data link allowing in-flight reprogramming to new targets. They include improvements in accuracy to CEPs as close as three meters using aircraft or UAV designation, a hard target kill capability, and new sensors and seekers with at least some capability against mobile targets. They could include increased thrust rocket boost and new engine to increase range by up to 100 miles, hot weather-day performance, and launch depth for submarine launchings. A number of these improvements may also be incorporated into the on-going Block III upgrade.[55]

Providing a seeker for the Tomahawk would greatly improve terminal accuracy and kill capability since the DSMAC does not look forward and "see" the target, but rather flies to it. Equally important, improvements in mission planning systems and electronics will steadily reduce the time needed for mission planning, the ability to launch against a wide range of targets from ships without extensive external mission support, and the accuracy of targeting and mission profile data.[56] As is the case with many US efforts to act on the lessons of the Gulf War, however, the Tomahawk program faces serve funding constraints and it is unclear how many of these improvements will be fully funded through development and deployment.[57]

Table 10.3

US Navy Use of Tomahawk Missiles During the Gulf War

Date of Firing	Missiles Fired
17 January, 1991	122
18 January, 1991	58
19 January, 1991	32
20 January, 1991	8
22 January, 1991	8
24 January, 1991	6
25 January, 1991	11
26 January, 1991	7
28 January, 1991	2
29 January, 1991	3
31 January, 1991	19
1 February, 1991	6
Total	296

Source: Eliot Cohen, ed., Gulf War Air Power Survey, Volume V, Part I, Washington, GPO, 1993, p. 364.

The AGM-48E Stand-off Land Attack Missiles (SLAM)

The US Navy A-6E and F/A-18s only fired a total of seven developmental SLAM missiles, but such firings are interesting because they demonstrated the ability to equip naval aircraft with stand-off attack munitions.[58] The SLAM has a range of more than 50 miles and uses the airframe, turbojet power plant, and the 488 pound high explosive warhead and proximity or impact delay fuse of the Harpoon anti-ship missile. It uses the imaging infrared (IIR) terminal guidance capability of the AGM-65D Maverick, the datalink capability of the AGM-62 Walleye glide bomb, and a GPS receiver. The seeker video is transmitted to the system operator who recognizes, acquires, and selects the specific aim point on the target.

The SLAMs used in the Gulf War were deployed from carrier-based aircraft and used targeting data loaded into the missile before take-off. They used GPS data, mid-course guidance assistance, and video aim point control to provide a precision strike capability that locks on the target. This makes the missile autonomous after lock-on and minimizes collateral damage. The SLAM's data link system allows the missile to be launched by one aircraft, and guided by another aircraft, normally positioned out of danger more than 60 miles away from the target.

Like many developmental weapons or technologies employed in the Gulf War, the SLAM was not effective. Its continuing video tracking did aid in damage assessment, but its AAW-9 data link pod proved to be unreliable and is being replaced by the AAQ-13. The SLAM is also scheduled to undergo post-war test and evaluation, and a product improvement program that reflects a number of other problems that emerged during the Gulf War.[59] This program will be used to upgrade the missiles that the Navy has in inventory, and will increase stand-off range and the ability to lock-on to a wider range of targets. It will provide more effective warhead penetration capability against hard targets, reduce mission planning time, improve the range and reliability of the data links, and anti-jam performance. The Navy has funded 514 missiles and has a procurement goal of 700.[60]

Integrating Naval Air and Missile Strike Capabilities

If the US Navy has been slow to admit some of the operational problems in the Tomahawk and SLAM during the Gulf War, it has not been slow to draw the proper lessons from the war. It not only is seeking to modernize and upgrade the Tomahawk and SLAM, it is seeking to create an integrated capability to use both Naval air power and Naval missile power as part of a Navy Strike Warfare Master Plan and an integrated strike planning system.[61]

This could provide a formidable potential strike capabilities are formidable. While the Navy has phased out its battleships, which could carry 32 TLAMs in eight quad box

launchers, it retains many smaller ships that can deliver larger numbers of missiles. During the Gulf War, the GCN-9 and CGN-38 cruisers could carry eight Tomahawks in two quad box launchers. The GG-47 Aegis cruisers could carry 0-122 missiles in two 61 cell vertical launch magazines. The DD-963 destroyer could carry either 8 in two quad box launchers or 61 if the ship was modernized to use the vertical launch system. This class is being modernized so that 24 will have the VLS, and seven will have box launchers. The DDG-51 can carry up to 90 missiles, in one 29 cell VLS and one 61 cell VLS.[62] Submarines can carry cruise missiles instead of torpedoes. Advances in missile programming and mission planning capability will also allow such ships to use cruise missiles more flexibly and more accurately with progressively smaller electronics suites.

If the currently programmed improvements in the Tomahawk and its related retargeting capability are successful -- and if naval air power is supplemented by SLAM and the other joint service stand-off and "smarter" weapons described in Chapter Seven -- the Navy will also acquire a substantial near-stealthy long-range strike capability. This will allow it to project power in spite of the range limitations in its strike aircraft, and do so without risking a pilot. Such missiles cannot currently act as a full substitute for the flexibility and high payloads of a manned strike aircraft, but their value is certainly an important lesson of the Gulf War.

The Surface Warfare Campaign

The Coalition had already established unchallenged sea control over everything but Iraqi and Kuwaiti coastal waters during Desert Shield. It also assembled so much seapower by the time that Desert Storm began, that the surface warfare campaign was similar to using a sledgehammer to smash an ant: The Coalition sometimes had minor problems, but the outcome of the naval battle was never in doubt.

Iraq's Limited Naval Capabilities

Iraq had never given its navy high priority, or established high training and readiness standards. Its navy had played a negligible role during the Iran-Iraq War, and had been allowed to decline in readiness immediately after the war because it was awaiting delivery of major new ships from Italy. When Iraq invaded Kuwait, it had limited port facilities and access to the Gulf. Its main port facilities were concentrated near Basra, along the Shatt al-Arab, at Az-Zubayr, and Umm Qasr. Iraq was able to use its off-shore oil terminals at Khawr Al Amaya and Mina Al-Bakr as bases for limited helicopter and small craft operations, but these were near the coast and had little strategic value.

The Iraqi Navy was able to carry out some missions during Desert Shield, when it could operate freely in coastal waters. Iraq used its navy to patrol the coast and occupy

several islands, and lay thousands of mines.[63] It succeeded to the point that its mine fields helped discourage a Marine Corps amphibious attack and damage to several US ships.

Once the fighting began Iraq's navy had no capability to survive the mix of air and naval power that the Coalition could bring to bear. The Iraqi navy's only major combat ships consisted of an obsolescent Yugoslav 1,850 ton training ship called the *Ibn Khaldun* or *Ibn Marjid* (507), and six Osa II and two-three Osa I-class guided missile fast attack craft. The frigate had no combat capability, and the Osas had serious limitations. The Soviet-built Osa I and II were capable of speeds up to 40 knots, although the Osa II is more powerful and slightly faster than the Osa I.

The speed and maneuverability of patrol boats had little value, however, against naval forces armed with modern anti-ship missiles supported by aircraft. The combat power of the Osa missile patrol boats depended almost solely on the quality of their missile systems. Each of the Osas had a launcher that carries four Styx anti-ship missiles. This missile had a maximum range of 46 kilometers -- or 95 kilometers with remote target acquisition, but its an old design that was vulnerable to intercept and countermeasures, and the Osas had only limited long-range target acquisition capability.[64]

Iraq's only other operational combat ships consisted of three large SO-1 patrol craft, four to five Zhuk coastal patrol craft, two Soviet T-43 and three Yevgenya-class oceangoing minesweepers, three Nestin-class inshore minesweepers, three Polnocny-class LSMs and three LSTs. The T-43s were 580-ton vessels that had two 37mm and two 25mm guns, two depth charge throwers, and a magazine that could release up to 25 mines. The Yevgenya-class vessels were 80-ton craft limited to minesweeping. The Nestin-class craft were Yugoslav-built craft designed for river use, but could be used to lay mines in shallow waters and block amphibious landings.

The Polnocny-class LSMs had been modified to add a helicopter deck, and two 18-tube multiple rocket launchers, and could carry six tanks each, but had no surface warfare capability against other ships. The Iraqi Navy's support vessels included two old Poluchat-class torpedo support ships, one tanker, and one small support ship. Iraq was a awaiting deliver of a support ship called the *Agnadeen* and a dry-dock, but both were still in Alexandria when the Iraqi invasion of Kuwait began, and remained there during the war.

Iraq's conquest of Kuwait did give it some additional naval assets. It acquired three more ports -- Ash Shuwayk in Kuwait City, Mina Al Ahmadi, and Ash Shuaybah along Kuwait's southern coast. It seized control of six islands off the coast of Kuwait -- Bubiyan, Faylaka, Awah, Kubbar, Qaruh, and Umm al-Maradim -- which it could use as limited bases for raiding and threatening amphibious operations. It acquired the Ad-Dawrah offshore oil field, about 40 kilometers east of Kuwait's southern coast, which it could use

for the same purpose. It also seized five Kuwaiti TNC-45 and one FPB-57 missile patrol boasts with the Exocet, a more advanced anti-ship missile with a maximum range of 96 miles with remote targeting. It could only barely operate these vessels at the time of Desert Storm, however, and never used any of them effectively in combat.

Iraq had no specialized naval intelligence aircraft like the EP-3, no maritime patrol aircraft like the Nimrod, or PC-3, and no specialized armed scout aircraft like the S-3. The Coalition was able to use such aircraft to target Iraq surface forces and help control attacking Coalition aircraft in air attacks on Iraqi naval and surface targets.

The Iraqi Air Force had aircraft and helicopters with Exocet air-to-ship missiles, but its aircraft could not survive in the fact of the threat posed by Coalition fighters like the US Navy F-14 and Canadian CF-18s which operated over the Gulf. Coalition air supremacy also meant that naval attack aircraft like the A-6E and F/A-18 could be used freely against Iraqi ships.

The Iraqi Navy also had nothing approaching the capability of British Lynx units -- which had radar guided missiles, US Navy SH-60B electronic surveillance units, or US Army OH-58D units which were part of a small task force deployed on US Navy ships, and which could be used to assault Iraqi oil platforms and land targets.[65] The Coalition battle force commander normally had 2-5 British Lynxes, 10-23 US Navy SH-60Bs, and four US Army OH-58Ds available for surface warfare support. The number of Coalition helicopters assigned to the surface warfare role increased steadily between January 24 and February 4, as it became clear that they were not required for mine surveillance.

Iraqi Missile Attacks on Coalition Surface Forces

Iraq had significant land based anti-ship missile forces. These included seven land-based Silkworm launchers, and a total of approximately 70 Silkworm cruise missiles. These missiles had ranges of up to 68 miles and could use an active seeker for terminal target acquisition. Iraq had never used these systems effectively in combat, however, and its Silkworm forces had only limited proficiency.

Iraq only carried out one missile attack on Coalition surface forces during the war. On February 25, the battleship *USS Missouri* moved within 10 miles of the Kuwait coast to use its “16" guns to support advancing Coalition ground forces and cover an amphibious feint by the *USS Okinawa*. Iraq launched two shore-based Silkworm missiles at the *Missouri* and her escorts. The first landed in the sea, possibly confused by ship launched chaff. The *HMS Gloucester* detected the second Silkworm with about a 30 second warning, and destroyed it with two GWS.30 Sea Dart missiles.[66] US E-2C and DP-3 aircraft located the missile site, and coordinated an A-6E strike with Rockeye cluster bombs. Reports at the time that this air strike destroyed the site now seem questionable. It is unlikely that

Coalition forces destroyed a single Silkworm missile. The strikes probably did, however, suppress the site and destroy some fixed facilities.[67]

The performance of the *HMS Gloucester* is important both in demonstrating the ability of surface ships to hit anti-ship missiles, and the fact that at least the Royal Navy and the US Navy can cooperate in such demanding missions. At the same time, the Silkworm is scarcely one of the world's most advanced anti-ship missiles, and Iraq did not employ it particularly effectively. Iraq had never received its order of modern Otomat missiles, and made no serious attempt to use its more advanced Exocet missiles. While it is clear that the need for effective anti-ship missile defense is a critical lesson of modern warfare, the Gulf War scarcely provides new insights into that lesson.[68]

Coalition air forces did, however, find it as difficult to attack Iraq's Silkworms as it did to attack Iraq's Scuds. The Gulf War Air Power Survey notes,[69]

> "The attacks against Silkworms contained many of the same frustrations as the attacks on Scud sites. Although intelligence identified seven Silkworm sites before the war, repeated strikes on the sites did not remove the threat. There were forty-five strikes in all, beginning at the end of January, and half of those were during the ground offensive. The fixed sites suspected of being decoys, (and) because (of that) an increasing number of strikes were not made against identified sites, but against suspected sites in adjacent areas. Only two launches were recorded during the war, from a site south of Kuwait City in 25 February...Just as for anti-Scud operations, one cannot judge to what extent the attacks suppressed launches. The Iraqis may have retained the missiles for use only in the event of an amphibious landing, or they may simply have lacked sufficient data to attack Coalition ships."

This failure to successfully attack the Silkworms is a potentially important lesson of the war because several other potential threat nations have Silkworms or similar missiles. Such nations include Iran, Libya, and North Korea -- as well as many less threatening states. Like the "Scud Hunt" described in Chapter Eleven, there is a clear requirement for better systems to locate and target land based anti-ship missiles.

The Beginning of Naval Surface Warfare During Desert Storm[70]

The Coalition was far more effective in using its missiles and aircraft to attack Iraqi naval forces. The first surface warfare engagement took place on January 18, when US carrier strike aircraft engaged two Iraqi gun boasts, including a TNC-45, and a Sawahil-class service craft operating from oil platforms. That night, several aircraft reported anti-aircraft fire from the Ad-Darah offshore oil platforms, and US, British, and Kuwaiti ships and helicopters attacked the platforms. Lynx and OH-58 helicopters attacked and

neutralized the platforms outside naval gun range to make sure that they could not fire Exocet missiles, and the *USS Nichols* and the Kuwaiti *Istiqlal* then shelled the platforms and eliminated their surface-to-air missile threat. The Coalition also used A-6s to mine the mouth of the Khawr Az-Zubayr River to restrict Iraqi naval access to the Gulf.[71]

On January 22, a P-3C detected Iraqi tankers carrying out surveillance operations and launching a hovercraft. A-6s damaged the tanker and sank the hovercraft. On January 24, A-6s destroyed an Iraqi minesweeper and patrol boat, Saudi ships fired a Harpoon at an Iraqi utility craft, and an Iraqi minesweeper sank after hitting one of its own mines while trying to evade an A-6. That same day, US Navy SEALs reacted to fire on Coalition ships from Qaruh Island, conducted a heliborne assault on the island, and liberated it for Kuwait.[72]

Coalition Helicopters and Aircraft Versus Iraqi Missile Patrol Boats

On January 27, USNAVCENT -- the Coalition surface warfare commander -- became concerned that Iraqi naval forces might flee to Iran, and positioned ships and aircraft to intercept any fleeing ships. On January 29, RAF Jaguars detected 15 Iraqi patrol boats moving from Ras al-Qulayah to Mina al-Saud.[73] Four British Lynx helicopters from three Royal Navy ships, working with a controlling US Navy SH-60B, and located the Iraqi force. The Lynxes worked with the SH-60 because it had a superior radar and processing power and could provide area surveillance.[74] Visibilities in the Gulf were often limited, and the Lynxes were able to maneuver well within the 9 mile (15 kilometer) range of their Sea Skua missiles and damage or sink two Iraqi ships while scattering the rest. The surviving Iraqi ships were then attacked by Coalition aircraft, which sank 10 of the 15.[75]

It is not always possible to determine exactly how lethal the Lynxes with Sea Skuas were -- because it often is not possible to clearly distinguish the damage done by the Lynxes from later damage by US aircraft. It is clear, however, that the combination of SH-60s and Lynxes with Sea Skuas was highly effective. The Lynxes fired 26 missiles and seemed to have damaged or sunk a total of 10-15 Iraqi ships. This total may include five TNC-45 missile patrol boats with Exocet, two T-43 minesweepers, two Polnocny landing ships, two Zhuk-class patrol boats, and two assault boats.[76]

The Lynxes also proved to be valuable scouts for US AH-1s when the target did not justify expenditure of a Sea Skua missile.[77] Further, the Lynx pilots quickly found that they did not need to carry the ALQ-167-V "Yellow Veil" jammers carried during their initial flights, and this allowed them to carry four missiles per flight.[78]

These encounters demonstrated the value of using combinations of search and attack helicopters, and the value of advanced helicopter-launched anti-ship missiles. They are also an example of a case where another Coalition state had better weapons and

technology than US forces. Although the US Navy had purchased the Norwegian Penguin missile, it had not armed its naval helicopters with the system. In contrast, the Royal Navy Lynxes were equipped to carry out an autonomous search for targets with their Sea Spray radars and engage outside the air-defense range of most patrol boats and FACs. The Sea Skua's also had four preprogrammed flight profiles and semi-active seekers so that Lynx could maneuver freely after firing. They were fitted with special long range thermal imaging systems for night warfare, an integrated Doppler radar and GPS for accurate navigation, .50 caliber machine guns, and a mine hunting video camera system designed to find mines near the service, but invisible to the eye.[79]

The US Navy concluded from the British experience with the Lynx and Sea Skua that this was, "the most effective anti-surface warfare tactic used by the Coalition...Providing US Navy helicopters with a similar weapon would make them more effective... and extend the striking power of US combatants."[80]

The Coalition also made effective use of its fixed wing aircraft. On January 27, an A-6E detected four Iraqi ships moving south of Al-Faw towards Iranian waters. In spite of night, poor weather, and oil smoke, an E-2C was sent to investigate and identify the Iraqi ships as hostile, and then authorize the A-6 to attack. The A-6E hit two of the ships with laser- guided bombs, and assisted an F-18 in striking a third with a laser-guided bomb. The US aircraft then ran out of LGBs, but the E-2C called in two CF-18s which strafed the fourth ship repeatedly. An Iraqi FPB-53, FPB-70, and TNC-45 were found capsized, and an OSA was later seen in an Iranian port with extensive strafing damage.[81]

These encounters began a large scale series of engagements during January 29-30, as the Iraqi Navy attempted to escape to Iran. Guided by P-3Cs, Coalition helicopters and strike aircraft carried out 21 engagements against Iraqi ships. A FPB-57, three Osas, and 2-3 TNC-45 missile boats; a T-43 mine sweeper; and three Polnocny amphibious ships were heavily damaged. On January 31, Coalition helicopters attacked and seized Mina al-Bakr and damaged another TNC-45.[82]

By February 2, the Coalition had destroyed or damaged all 13 Iraqi ships capable of firing anti-ship missiles. On February 8, USNAVCENT declared that the UN had achieved sea control of the northern Persian Gulf. The Iraqi Navy had effectively been reduced to conducting minor raids, and Coalition operations consisted largely of tracking Iraqi movements, and attacking any ships that attempted military action. This, however, involved only limited military encounters. For example, British Lynx helicopters attacked a total of five Iraqi ships after February 8. The *Istiqlal* fired its gun and an Exocet at an Iraqi patrol boat on February 16. US SH-60Bs destroyed an Iraqi Silkworm launcher with Hellfire

missiles on February 18. A US Navy S-3 destroyed an Iraqi gunboat with 500 pound bombs on February 20.

If Iraq was able to operate the air defense systems on its captured Kuwaiti vessels, however, they had no impact on the fighting. The early Coalition helicopter attacks on Iraqi ships were carried out by helicopters using ALQ-167 Jammers. The only attack on a Lynx, however, was a shoulder fired SA-N-5 Grail missile that did not damage the helicopter. While Iraqi radars may have detected the Lynx helicopters, they also never got a secure lock on one.

As a result, Lynxes began to attack on the second day with additional missiles instead of jammer pods. The electronic support measures on the Iraqi TNC-45s and FPB-57s seem to have been unable to detect the emissions of the Lynx's Sea Spray radar, and the fact the radar had a fire control lock on the Iraqi ship, in time to initiative countermeasures before the Sea Skuas struck. In contrast, the Lynxes could use their Orange Crop electronic support measures to obtain warning of a possible lock-on by the Iraqi ships, and could break the Iraqi radar, contact by simple maneuvers without losing their ability to fire the Sea Skua.

Coalition aircraft continued to strike at Iraqi ships in port and at Iraqi naval facilities during the rest of Desert Storm. Reliable battle damage data are not available on the impact of these air strikes on Iraqi naval forces, but the US Navy estimated that the Coalition had destroyed or damaged a total of 143 Iraqi ships, searched and secured all of the northern Gulf oil platforms, and significantly damaged all Iraqi naval bases by the end of the war. [83]

The Coalition estimated that a total of 11 anti-ship missile patrol boats had been destroyed and two damaged, nine minesweepers had been destroyed, and 116 small patrol boats and auxiliaries had been destroyed or damaged. Iraq's losses included both of its Osa II guided missile patrol boats, 4-5 Osa I guided missile patrol boats, the frigate *Ibn Khaldun*, all 4 Zhuk-class patrol boats, its T-43 minesweepers, 1-2 Yevgenya-class inshore minesweepers, three Nestin-class riverine minesweepers, 2-3 Polnocny-class LSTs, and five small patrol boats.[84] What is certain is that Iraq's navy was virtually destroyed as an operational force. All of the ships that it had captured from Kuwait were either destroyed or returned to Kuwait.

The Weaknesses of Iraq's Guided Missile Patrol Boats

There are a number of reasons other than sheer force of number and superior technology that the Coalition was so successful against the Iraqi missile patrol boats.[85] Iraq's aging Osas lacked meaningful air defense capability. They only had twin unguided 30 mm anti-aircraft guns and limited anti-air radar capability. Their only guided air defense

weapon was the man-portable SA-N-5 (SA-7) surface-to-air missile, which was outranged by the Lynx helicopter when it fired Sea Skua missiles. The captured Kuwaiti TNC-45 and FPB-57 missile patrol boats, however, were modern Lurssen-built ships with radar guided guns. They had OTO Melara 76/62mm COMPATTO turrets and Breda twin 40/70mm turrets directed by sophisticated BEAB fire control systems, and were equipped with DAGIE decoy launchers, and electronic support measures.

Some experts feel that the limited size of all such guided missile patrol boats created problems that went well beyond the specific equipment on the Iraqi ships. They feel that an examination of the films of Lynx attacks indicate that the Iraqi ships could not lock their radars on the approaching helicopters because the radars were so close to the water that they experienced major problems with multipath effects. These effects can cause the ship's fire control radar to oscillate between the real image and a radar mirror image and lead to a major loss of precision. They also feel that the size of the ships prevented them from being equipped with the sensors, weapons, and battle management space necessary for effective air defense, which created ergonomic problems in trying to operate both the offensive ship-to-ship missile system and the air defense systems.[86]

If such experts are correct, these broader problems with missile patrol boats are important lessons of the Gulf War. Many of the world's navies use missile patrol boats similar to Iraq's. Such problems raise serious doubts about the value of much of the Third World's naval strength and many of the current procurement plans in Third World forces. At the same time, one must be careful about drawing either technical conclusions, or conclusions about a whole class of ships, from the performance of one of the worst-led, organized, and trained navies in the Third World. Post-war analysis of Iraqi ships and prisoner of war reports indicate that many of Iraqi missile patrol boats had severe operational effectiveness problems before Desert Storm because of a lack of crew training and readiness, and the Iraqis inability to properly operate the ships they captured from Kuwait. [87] It is not clear whether the lesson of the Gulf War is that it helps to fight bad ships, bad sailors, or both.

Other Lessons from Naval Surface Warfare

There is no doubt that sea control was critical to the Coalition, but was never contested. There is also no doubt that Coalition naval forces generally worked well, and that they demonstrated the value of Coalition and joint warfare, naval attack helicopters and missile armed helicopters, maritime patrol and intelligence aircraft, special forces like the SEALs, air attacks on land-based anti-ship missile site, night and poor weather warfare capability, air and anti-ship missile defense ships, and ships capable of managing large scale air operations.

These are all important lessons of the war, and the US Navy concluded after the war that it needed better ways to identify the nature and activities of smaller vessels, provide flexible air attack options without duplicative strikes, and assess damage before additional strikes were called in on damaged or sinking ships.[88] At the same time, it is impossible to translate the Coalition's experience into detailed lessons about individual weapons systems or capabilities against more significant opponents. Iraq was simply too weak a force.

The Gulf War may pose another lesson, however, about the risk of careless transfers of weapons to aggressive and/or authoritarian states. Iraq's performance might have been better if the Iraqi Navy had been able to obtain the warships that it ordered from Italy long before the Gulf War. Iraq was awaiting delivery of four Lupo-class frigates six Wadi Mr'agh-class corvettes, and the supply-ship *Agnadeen* in 1986, but all of the Italian combat ships were still at La Spezia when the war began.

The corvettes were relatively capable 610 ton vessels. They had comparatively low range and endurance, but they were capable of maximum speeds of 37 knots, and armed with twin modern Otomat II missile launchers, one four cell Albatross surface-to-air missile system, an Oto Melara 76mm gun, and an Agusta A-109 helicopter. They had modern radars and sonars and relatively advanced commercial grade electronic warfare equipment.[89] The frigates were relatively large 2,525 ton vessels and each was armed with eight Otomat II ship-to-ship missile launchers (160 kilometer range), one Oto Melara 127mm gun, six 324 mm torpedo tubes, one Albatross/Aspide surface-to-air missile launcher with eight missiles, and one Agusta AB-212 ASW helicopter. [90]

Weapons transfers alone, however, rarely make dramatic increases in the capability of poorly led, trained, and organized navies. Delivery of these frigates and corvettes might have shifted the naval balance in Iraq's favor against Iran and Saudi Arabia. It is doubtful that they would have been able to survive British and US air attacks for more than a few days. The same would have be true of the ships that Iraq captured from Kuwait, even if the Iraqi Navy had had more time to learn how to operate them effectively.

The Cost of Desert Storm to the Iraqi Navy

The Iraqi Navy suffered more from the aftermath of the Gulf War than any other Iraqi military service. In 1995, it still only had a strength of about 1,600-2,000 men, and its surviving forces only included limited use of the frigate *Ibn Khaldun* , a repaired Osa-class missile boat, 13 light combat vessels, 5-8 landing craft, 1 Yugoslav Spasilac-class transport, a floating dry-dock, and possibly a repaired Polnocny-class LST. While some sources reported that Iraq had three 5,800 ton roll-on roll-off transport ships with Helicopter decks, a capability to carry 250 troops and 18 tanks, and the ability to embark small landing craft -- these ships were commercial, and did not have the ability to beach.[91]

Iraq's lighter surviving combat ships only included a maximum of one Osa-class guided missile patrol boat (doubtful), one-two Soviet-supplied Bogomol-class patrol boats, two Zhuk-class patrol boats, one Poluchat-class patrol craft, six PB-80 coastal patrol craft, some Sawari-class small inshore patrol boats, six SRN-6 hovercraft, and some small boasts. Its surviving five mine craft included two Soviet Yevgenya-class and three Yugoslav Nestin-class boats.

The Bogomol-class patrol boats were the only surviving craft large enough to be taken seriously. They may, however, be damaged. They also are only 245 ton vessels and normally carry only a 76mm gun, a 30mm Gatling gun, and one SA-N-5 missile. This is a negligible combat capability, but it is possible that Iraq could refit them with one or two anti-ship missiles.

Iraq had little near-term potential to rebuild its forces. The two Italian frigates it had bought -- the *Mussa Ben Nussair* and the*Tariq Ibn Ziyad* -- were being held by Italy at La Spezia.[93] The *Agnadeen* and Iraq's floating dry-dock were held in Alexandria in Egypt, and all three of its roll-on roll-off transports were held in foreign ports.[94] Iraq also had even less access to the Gulf than it had when it invaded Kuwait. It was forced to virtually close its naval base at Umm Qasr, and use small craft and civilian ships for patrols in coastal areas. Virtually all of the larger ships that were still under its control were laid up in Khor as Zubair, Basra, and Mina al-Bakr. Iraq retained a limited mine warfare capability, and some of its land-based Silkworm missile systems. It may also have had some Faw 70, Faw 150, and Faw 200 missiles. These are Iraqi-made versions of the Soviet SSC-3 Styx, are obsolescent designs at best.[96]

In summary, the Gulf War only left the Iraqi Navy with a very marginal war fighting capability. It could conduct limited raids and fire some anti-ship missiles, but could not hope to survive a serious encounter with Iranian or Western naval and air forces. To the extent that Iraq had any serious ability to threaten foreign naval forces, this consisted of the Iraqi Air Force's remaining Mirage F-1s armed with the Exocet anti-ship missiles. Iraq did not retain any of the medium bombers armed with air-to-ship missiles that it had when the Gulf War began, but it may have retained six to seven of the 13 Aerospatiale SA-321s, armed with Exocet air-to-surface missiles that it obtained during the Iran-Iraq War.

Mine Warfare and Anti-Mine Warfare.

Mine warfare was one of the few areas where the long pause between Iraq's invasion of Kuwait and the beginning of Desert Storm acted to Iraq's advantage. Iraq used the time to deploy an extensive set of minefields off of the coast of Kuwait, which affected both the Coalition's options for amphibious warfare and many of its other naval operations. Iraq's

minelaying strategy concentrated on protecting its coastal flank from an amphibious invasion. Iraq began intensive minelaying in late November, and used two main methods of offshore mining. It laid fields of moored and bottom mines, and single lines of mines. Iraq also seems to have set some mines adrift to disrupt naval and commercial traffic in the upper Gulf, and damage Coalition ships.[97]

Iraqi Minelaying Efforts and Capabilities

The Gulf is ideal for mine warfare because it is rarely more than 100 feet deep so mines can be left on the bottom in areas well within the range of their sensors and release system. Such mines are often designed to blend into the bottom, so it normally takes a specially designed sonar, and often a remotely controlled submersible to verify they are in place. They are particularly difficult to clear because sonar finds it much easier to detect such mines if it can compare a map of the area without mines to any changes the mines may make.[98]

Iraq is estimated to have possessed eleven different types of mines at the time of the Gulf War, and to have laid 1,000-2,000 mines before the beginning of Desert Storm. Most of its mines were contact mines based on Russian designs from the period before World War I, but they also included high technology magnetic and acoustic influence mines. The moored contact mines included the Myam, Soviet M-08, and an Iraqi copy of the M-08 called the LUGM-145. These are simple mines that are moored to the bottom with an anchor and a chain, and explode when a ship's hull hits one of their sensors

Iraq's bottom acoustic influence mines -- which are triggered by the sound or a ship's propeller or the magnetic signature of its hull -- included the Italian Manta acoustic/magnetic mine, the Soviet KMD magnetic influence mine, the Soviet UDM acoustic influence mine, and the Iraqi produced Sigeel 400 mine. According to one source, the Sigeel 400 is an air droppable non-magnetic bottom mine detonated by an acoustic sensor which can be set for the frequencies of Western mine sweepers, and will then attack a mine sweeping effort with 400 kilograms of explosive. Iraq does not seem to have had mines with sophisticated pressure sensors that detect the passage of a ship's hull.[99]

Iraq could deliver these mines from auxiliaries and small boats, and from using rail-equipped mine sweepers and landing craft, and could use virtually any small boat as a minelayer. Iraq's Super Frelon helicopters could also be used to lay mines, and Iraq may have had the capability to use the Hip helicopter and the B-6 bomber.

During Desert Shield, Iraq created minefields that extended north from the area near the junction between the Saudi Kuwaiti border around the islands of Umm al-Maradim and Qaruh to positions just west of the Ad-Darah oil fields. These minefields were located slightly to the northeast to a point roughly parallel with the island of Awhah, and finally

turned west towards the southeastern end of Bubiyan. Single mine lines were laid east of Bubiyan south to positions just east of Qaruh, and west of Qaruh on an angle pointed toward Kubbar and the junction of the Saudi-Kuwaiti border. Iraq reported after the war that it had laid a total of 1,167 mines. The planned density of its minefields covering the shore was 60 per nautical mile, at a depth of 10-40 feet, an additional 600-1,600 per nautical mile at a depth of 0-10 feet, plus 3,200-6,400 anti-personnel mines on the beach.[100]

Iraq also seems to have used drifting mines. Saudi mine vessels first detected Iraqi mines drifting in the Zuluf oil field on December 21. Some of the floating mines may have broken free from moorings, but the Coalition found that at least 20% of the recovered mines had no mooring chains attached and little marine growth or corrosion.[101] Iraq may have used small rubber boats to lay a maximum of four floating mines per boat. These small boats operated out of Ras Al-Qulayah, and seem to have laid at least 20-25 mines.[102]

This experience is an important lesson for the future because the release of floating mines is difficult to detect, and such mines are hard to locate once they began to drift. Although the risk of a such a mine actually hitting a ship was limited, it had to be considered throughout the conflict and extended the range of Coalition mine countermeasure activity. Drifting mines also presented a special problem for the carriers in the Gulf because the intensity and speed of carrier operations limited the effectiveness of helicopter searches and mine watches.

Western Mine Countermeasure Efforts and Capabilities

The US Navy had significant problems in dealing with the Iraqi mine threat. Although the US Navy had begun to improve its mine warfare capabilities as a result of its experience in dealing with Iranian mines in 1987-1988, it still had relatively limited capabilities at the time of the Gulf War. The scale of the improvement in US capability was also unsuited to the demands of regional warfare. While its experience during the Iran-Iraq War should have been a lesson that it need to improve its minesweeping and countermeasure capabilities, the US Navy still planned its force structure around a European war where its NATO allies would take on the main burden of mine countermeasure (MCM) activity. This is an important warning about the risk of planning global power projection forces on the basis of a limited number of most probable scenarios in a very uncertain world.

US mine warfare capabilities consisted of four kinds of mine countermeasures: surface, air, explosive ordnance disposal, and the use of special operations forces. Its surface capabilities were limited to a US Mine Countermeasures Group (USMCMG) composed of one newly commissioned Avenger-class ship (MCM-1) and three thirty-year old Aggressive and Acme-class minesweepers. Its air capability consisted of six MH-53E

helicopters, and the smaller SH-2F Seasprite which were equipped with experimental Magic Lantirn laser mine detection systems. The USMCMG also had 20 explosive ordnance detonation teams and the support of a 23 man Australian team. Two UAE-flagged ships were placed under contract to act as support ships for the US explosive ordnance detonation teams.

The US minesweepers could not self-deploy -- largely because of concern over the life of the Avenger's diesel engines. They arrived on September 30, 1990 on a Dutch heavy lift ship, the helicopters arrived by C-5A on October 7, and an LPH, the *USS Tripoli*, was assigned as the command ship for the mine hunting group and to provide a base for the helicopters on January 22, 1991.[103] The basic technology that the US had available for mine countermeasures on these forces was limited -- a problem that led the Secretary of the Navy to state after the Gulf War that, "We spent more than 25 years not developing or buying new minesweepers or mine hunters."[104]

The US Navy had never procured mine avoidance sonars for its ships like the British Navy. The *Avenger* was the only operational modern mine countermeasures ship in the US Navy when the Gulf War began, but it was still close to the trials stage. The *Avenger* used the AN/SQQ-32 mine hunting sonar to detect moored and bottom mines, the AN/SSN-2 precision navigation system, the AN/SLQ-37 influence minesweeping system, and the AN/SLQ-48 mine neutralization system to locate, characterize, and destroy mines. The AN/SLQ used a remotely piloted submersible that was equipped with sonar, two TV camera, explosives for neutralizing mines, and cable cutters to cut the mooring and allow the mine to float to the surface where it could be destroyed. The *Avenger* detected the first Iraqi Mantra mine, but then had mechanical and power generation problems and all four of its diesel engines had to be replaced. Its engines are being replaced with a different type in later ships of the class.[105]

The older US minesweepers and MH-53Es had not proved particularly effective against the old M-08 mines that Iran had used in 1987-88. They only had the obsolete AN/SQQ-14 sonar to detect mines, and mechanical minesweeping gear to cut mooring cables. The MH-53Es towed a cable with a mechanical cutting device to cut mooring cables, and towed acoustic and magnetic sleds -- which simulated the propeller noise and magnetic signature of a ship in order to detonate influence mines.

The British Navy provided more capable surface assets and had a more realistic understanding of what mine countermeasures could be expected to accomplish -- an understanding that helped temper a number of over-ambitious US Navy operational plans which either underestimated the mine threat or over-estimated Coalition mine countermeasure capabilities.[106] Britain initially deployed three Hunt-class mine hunters,

which had a support ship and more modern sensors and countermeasure equipment than the US ships. This force was reinforced by two more mine hunters as time went on. At this point, the British Navy formed a separate mine warfare group with the *Atherstone, Cattistock, Dulverton, Hurworth*, and *Ledbury* , and the tank land ship *Sir Galahad* as a support base. Britain had sold its only specialized mine countermeasure support ship, the *Abdiel*, before the war.

The British force took the lead in most of the mine countermeasure operations during Desert Storm. It cooperated closely with the US Navy, and sometimes used US Navy divers.[107] It proved to be highly effective, and opened the sea approaches exploited by the US battleships.[108] Belgium contributed two Tripartite-class mine hunters, plus the support ship *Zinna*, but Belgian forces operated in the Gulf of Oman -- outside the combat area. Saudi Arabia provided four mine countermeasure forces that were used to sweep waters along the Saudi coast.

The total Coalition mine countermeasure force that was actually available to cover the upper Gulf and Kuwait coast was limited, however, and had a number of technical limitations. Although all of the British and US ships theoretically had the capability to detect and counter all types of bottom and moored mines, the actual effectiveness of some of these systems was uncertain, searches were slow, and there was a risk that sweeps would leave mines in a swept area. The problems that these forces faced were also increased by a number of restrictions on naval and air operations in the Northern Gulf. As one US study of the war indicates,[109]

> "To avoid any possibility of provoking Iraqi military action before the Coalition defensive and later offensive preparations were complete, USCINCENT restricted naval surface forces to operating ... approximately 55 miles south of the Kuwaiti-Saudi border...unless tactically required to exceed that limit. Those restrictions precluded intelligence gathering on Iraqi mining activity, and also prevented USNAVCENT from acting to deter or counter Iraqi forces from setting mines in the Gulf"

Like the somewhat similar decision made to restrict the flight of reconnaissance aircraft over Iraq, this decision may have avoided provocation but it tolerated an act of war without a Coalition response, and it made the fighting worse once Desert Storm began. Mining activity in international waters is a hostile act under international law. Further, it was clear from the start that the Coalition would have inadequate mine countermeasure capability and would need every bit of information that it could get. Such a decision also made it very difficult to judge the potential quality of either the intelligence or

minesweeping effort, since both had to operate under a severe handicap that hopefully will not be repeated in future wars.

The Mine Warfare Duel During Desert Storm

Some aspects of the counter-mine effort could not wait for Desert Storm to begin. Once a Saudi minesweeper found a floating mine in December, the USMCMG began active operations and destroyed six floating mines. The USMCMG deployed in preparation for full-scale combat operations in Desert Storm on January 24, 1991. It carried out training exercises on its way to the northern Gulf, and on February 14, it was joined by the British minesweepers and the oceanographic survey vessel, *HMS Herald*.

The combined force started wartime mine countermeasure activity on January 16, when it began to clear a 15 mile long, 1,000 yard path through an Iraqi minefield south of Faylaka Island. It was escorted by a number of ships, including the Aegis guided missile cruiser, the *USS Princeton* , which provided air and missile defense.

The mine force was targeted by Iraqi Silkworm radars on February 17, and withdrew while Coalition forces located and destroyed the radar site. It resumed operations on February 18. After about 11 hours of mine countermeasure operations, the *USS Tripoli* -- a US LPH that acted as the flagship for the MCM effort and carried six MH-53E mine countermeasure helicopters -- hit a moored mine. The *Tripoli survived* its mine hit, and continued operations for several days, until it was relieved by the *USS La Salle* and the *USS New Orleans*. [110]

The next incident did more damage. While a number of ships went to the assistance of the Tripoli, the *USS Princeton* continued to provide an air defense patrol in what it thought were mine-free waters. In fact, the *Princeton* was sailing into an Iraqi Manta minefield. It actuated a Manta bottom mine in 16 meters of water and another mine blew up nearby because of sympathetic actuation.[111] The *Princeton's* superstructure was cracked, there was severe deck buckling, and the propeller shaft and rudder were damaged. Fortunately, the crew was able to control the resulting fires and flooding until the ship was towed out of the area by a salvage ship. They also were able to restore its TLAM and Aegis air defense capabilities within two hours, and provided coverage of the mine task force for another 30 hours, until relieved. [112]

These incidents illustrate the risks of mine warfare, and the fact that the Coalition had severe problems in characterizing Iraqi minefields and in detecting the presence of minefields. They also reflect the cost of the lack of intelligence priority and coverage given to mine warfare before the war. The mine countermeasure force had to operate with limited knowledge of Iraqi minelaying operations, and on the basis of one observation of one Iraqi merchantman moving through the area. As a result, intelligence had concluded that the

Iraqi's had laid their minefields closer to the coast, and that the entire Coalition MCM force had passed through the first minefield, and begun work on clearing the second, without ever having detected the first minefield. When the *Tripoli* and *Princeton* were struck, the Coalition was forced to more the entire operation 24 miles to the east, and resume operation in a new area.[113]

At the same time, it became clear after the war that the Iraqi minefields had many severe limitations that the Coalition had not detected before and during the conflict. This is a warning that the minefields may be much more effective in future contingencies. The USS *Avenger* detected and destroyed a modern bottom influence mine on February 27, but this was the first such mine the Coalition found, and most Iraqi mine fields seem to have used older contact mines. Examination of the Iraqi minefields revealed that the fields were not placed properly to maximize their efficiency, and many mines were deployed improperly. A large number lacked the sensors or batteries necessary for proper operation. The Coalition found that 95% of Iraqi UDM-type acoustic influence mines were inoperable. Several moored contact mines were found on the bottom, and about 13% of the moored mines broke away from their moorings.

The Coalition never had to come to grips with the full operational implications of the limitations in its mine countermeasure capabilities. It only had to provide countermine coverage for naval gunfire and amphibious feints, and it never made a direct large scale assault through mined areas. It is also clear that mine warfare had a broader impact on Coalition naval operations. As one Department of Defense study of the lessons of the war states,[114]

> "Kuwait's relatively short coastline, combined with the large Iraqi mine inventory, caused the Coalition MCM forces to plan and conduct MCM operations in support of an amphibious landing through dense minefields while vulnerable to missile, artillery, and small boat attacks from fortified beaches. Considering hydrographic and operational characteristics, an amphibious landing probably could only occur between Kuwait City and Ras al-Qulayah, along 30 miles of coastline...even the poorly planned and improperly deployed minefields caused damaged to two combatants and were one of the several reasons the amphibious invasion was not conducted. ...Other factors, such as collateral damage to Kuwait's infrastructure, risks to the land forces, and a lack of MARCENT requirement for a coastal supply route (also played a role)..."

The mine countermeasure effort also demonstrated that some of the limits of coalition and cooperative warfare. The Anglo-US mine countermeasure force was only able to use countermeasures against about 200 objects before the war ended --100 of which were

positively identified as mines.[115] French, Belgian, German, Italian, Japanese, and Netherlands mine countermeasure forces -- which were more sophisticated that any US mine countermeasure ship except the *Avenger* -- did not help during the war, and only joined the countermeasure effort after the war, when the Kuwaiti government paid them to clear the Iraqi minefields.[116] They cleared another 422 mines between February 17, and April 13 -- when their effort involved no risk of combat, and made no contribution to the war effort. Even so, the combined force did not clear the area until September 10.[117]

This lack of an allied role in war fighting was described as follows in a US Marine Corps analysis of the lessons of the war,[118]

> "This mine threat was a major factor in the planning and execution of the full range of naval operations, including interdiction, naval surface fire support, surface warfare, aviation strike operations, and amphibious operations. Because of the potential for mines, air-to-surface and surface-to-surface missiles, naval assets were placed at stand-off ranges...the long term implications of the US military's lack of effective mine countermeasures will not be lost on future protagonists...The mine threat is frequently characterized as an amphibious operations problem, but in light of the impact on the task groups in the Gulf, it must be viewed in the context of its impact on the full spectrum of naval power projection, and maritime operations...The US is presently dependent upon coalition forces for the preponderance of MCM support. This may be satisfactory for operations within the NATO theater, but is not adequate for the projection of US influence outside of that single area of responsibility. Inadequate numbers of US minesweepers to conduct our own sweeping operations causes an over reliance on helicopters for mine sweeping. This reliance has limitations and degrades amphibious operations. The first limitation is the lack of a night MCM capability on the MH-53E helicopter. Secondly, the utilization of an LPH-class flight deck for MCM operations takes a potential flight deck from the amphibious force."

Lessons of the Mine Warfare Duel During Desert Storm

There are obvious dangers in generalizing about the lessons of the mine warfare duel. The Coalition treated the Iraqi mining effort relatively passively during Desert Shield, and then did not fight a major countermine campaign of the kind needed to fully test its capabilities. Nevertheless, there are some lessons which do seem to emerge from the conflict:

- The Coalition mine warfare effort would probably have been more effective if the US had not decided to limit intelligence coverage of the Iraqi mining effort and had

attempted to enforce international law. The Gulf War indicates that a passive reaction to a mining effort greatly increases the problems of the countermine effort.

- The mine warfare effort might have been much more effective if nations that had specialized in mine warfare had not deployed their forces out of harm's way in areas where they served little purpose. It is not clear whether the US Navy made any major effort to seek the assistance of Belgian and Dutch mine forces for joint operations before Desert Storm, but it is one thing to talk about cooperative security and another to have cooperation. It is also one thing to have allies and another thing to have allies that fight The Royal Navy showed that cooperative security can have real meaning, but support from British forces is not enough. Other European powers and nations like Japan must be prepared to help. The current modernization of the Belgian mine force, for example, will do little good if it is only used when the fighting is over.[119]
- Desert Storm indicates that even if allied forces may be available, power projection forces must still be self-contained in capability. US dependence on allied mine warfare capabilities may have made sense during the Cold War, but it does not make sense in an era of major regional contingencies. The US has repeatedly found that it can achieve true cooperative security in operations with the Royal Navy, but this is not enough. The current modernization of the Belgian mine force, for example, does little good if it is only used when the fighting is over.[120]
- The US needs to find some form of wide area surveillance to detect minelaying and the presence of minefields in a given area. Finding and killing individual mines is only part of the need to upgrade mine countermeasure capability.
- The US Navy clearly needs a rapidly deployable mine warfare capability sized for at least one major regional contingency -- a lesson that it has already drawn for itself. It has taken delivery on nine more MCM-1s since the Gulf War, is taking delivery on the lead ship of the new MHC-51 class of mine hunters, and is converting the *USS Inchon* (LPH-12) to a mine countermeasures support ship. The Navy is upgrading the mine hunting gear and minesweeping sled on the MH-53E, and is seeking 15 deep water sweeps for the helicopter. It is developing a more advanced version of Magic Lantirn, and is looking at new laser and radar technologies. It is looking at the use of LCACs equipped with remotely operated vehicles for inshore countermine operations, the use of a small unmanned minesweeper which could be equipped with exploding mine nets to breach minefields at the shore, and the use of an autonomous under water vehicle for mine

searches. If current funding cuts do not affect this effort, it should have substantially better capability in the late 1990s.[121]

- There are some indications that the US allowed it planning for the mine warfare to become partially decoupled from the effort to plan amphibious warfare. The US did not turn the amphibious option into a deception operation until late in Desert Shield, and never rejected the need to provide a contingency capability to use amphibious forces to secure a supply point on the Kuwait coast. Such an operation might have been necessary if Iraq had chosen to treat Kuwait City as a "fortress" and fight urban warfare. Better joint planning was needed to link decisions about mine and amphibious warfare.
- Much of the literature published about the mine warfare effort during the Gulf War focuses on ship movements and individual mine countermeasure events, rather than on the quality of the technology available for mine countermeasure operations. Interviews with US and British naval officers indicate that the deployed mine countermeasure capabilities had very serious limitations in dealing with the more modern Iraqi mines. One senior officer with experience in the Gulf stated, "There really is no such thing as a modern mine countermeasure system. We can't do the job quickly and effectively enough over a wide enough area with anything we've got. There are promising technologies, but we have no way of knowing whether such promises will ever be kept."

In short, mine warfare must be taken seriously from the start of a crisis. It must not be treated passively and in ways that allow the creation of large minefields in international waters without a military reaction. Mine countermeasures are relatively high risk operations that must be fully integrated into national power projection capabilities and not left to "cooperative security". Simply buying more of today's systems is also not be enough. A range of promising, but classified technologies, need to be fully developed and deployed. This effort is called for in the US Navy Mine Countermeasure Program, and the US has created a Commander, Mine Warfare Command to give mine warfare suitable priority. The issue is now one of whether this effort is properly funded and implemented, and whether more realistic solutions can be found to obtaining allied mine warfare efforts in which all of the forces participate in combat.[122]

The Role of Naval Gunfire Support

The Gulf War may prove to be the last war in which heavy naval gunfire is used against land targets, as distinguished from 5" and 76mm guns, multiple rocket launchers, guided missiles, and naval air. Two US battleships, the *Missouri* and the *Wisconsin*,

played a major role in launching Tomahawk strikes, but also used 16" guns in a variety of roles.

The big guns on these two heavily armored ships provided a number of advantages. Their 2,700 pound shells were potentially very lethal and had a major range advantage over smaller guns. Many of the waters along the coast were too shallow for ships to close on coastal targets within range of their 5" guns. The added range of the 16" guns sometimes allowed the battleships to remain outside minefields, and their armor reduced the risk of Iraqi missile strikes or crippling damage from a mine hit. The battleships could fire their guns up to 26 miles, and use RPVs to acquire targets and measure the impact of their fire.

As a result, the *Missouri* and Wisconsin carried out a number of fire support missions from positions off the coast of Khafji against targets near the Saudi border, and from positions south of Faylaka Island and off the coast northeast of Ash-Shuaybah, against Iraqi targets in the coastal area from Ash-Shuaybah to the southern outskirts of Kuwait City. A battleship stayed off the coast of Khafji from February 4 to February 9, and one battleship was tasked with providing fire support during the ground offensive.[123]

The *Missouri* began operations on February 4, when it moved through a mine swept channel north of Khafji, escorted by a ship equipped with a SQS-56 sonar, and used Marine fire control direct to attack Iraqi C^3 bunkers, artillery sites, radar sites, and other targets. It fired 112 shells between February 4 and 6, often using UAVs to acquire targets. The *Wisconsin* relieved the *Missouri* on February 6, and attacked targets on February 6 and 8. On February 21, the two ships moved through recently cleared minefields to positions north to the area south of Faylaka Island. They fired pyrotechnic shells into Faylaka on February 23-24, as part of the deception operation to convince Iraq that the US would conduct an amphibious operation. On February 26, battleships provided fire support to the 1 US Marine Division by firing on Iraqi armor dug in near Kuwait International Airport.

Fire support took the form of pre-arranged fire, fire on self-determined targets of opportunity, and fire in response to requests from ground forces. About 64% of all fire missions (55% of shells fired) were directed against prearranged targets and 30% (40% of shells fired) against targets of opportunity. Only about 6% of the fire responded to direct fire support requests from ground forces.

Fifty-two missions -- about 65% of all missions, and 90% of all rounds fired -- received some form of spotting support. About 57% of all targets were acquired using UAVs, 3% came from OV-10 Bronco aircraft, and 2% came from ground spotting; 38% had no spotting or came from an unspecified source. US Navy UAVs flew a total of 164 sorties and 553 hours. They were also used to provide intelligence coverage of Faylaka

Island. These flights provoked a number of Iraqi troops to wave white flags, marking the first "surrender" to a UAV.[124]

Most of the fire before the ground offensive struck at Iraqi C^3 facilities (roughly 125 rounds), radar sites (roughly 60 rounds), and electronic warfare sites (roughly 55 rounds). Once the ground war began, fire concentrated on artillery positions and mortar batteries (nearly 300 rounds), ammunition storage sites (roughly 125 rounds), Silkworm batteries, and troops on the beaches (roughly 40 rounds).[125]

This naval gunfire was useful to Coalition operations, and only the battleships could have provided the range and weight of ordnance involved. The average range was 22 miles, and only 16 missions had ranges less than 18 miles. The two battleships carried out a total of 83 missions, and fired 1,102 sixteen inch rounds and a total of 2,166,000 pounds of munitions.

There is no way, however, to assess the effectiveness of this fire, and even official estimates are conflicting. Battle damage assessment data was only available for 37 of the 83 missions, or 45% of all rounds fired, and was generally most readily available for the gunfire that had the best targeting. This biases the sample where damage assessment data are available, and the Department of Defense and Department of the Navy drew different conclusions from the data. that are available. The Department of Defense found 40% light damage, 30% moderate to heavy damage, and about 28% of the point targets heavily damaged; they were easier to destroy with shells than scatted area targets.[126] The Department of the Navy found that naval gunfire resulted in 32% light to moderate damage, 26% heavy damage, 10% target neutralized, and 32% target destroyed.[127]

The battleships almost certainly performed a useful mission. At the same time, it is hard to translate any aspect of naval gunfire during the Gulf War into a lesson of war, or suggest any trade-offs between such gun fire and other weapons systems. The Gulf War was not a littoral conflict in the sense that primarily military action took place within naval gunfire range of the coast. If anything, it demonstrated that "coastal warfare" can have considerable depth from the shoreline. Naval gunfire support was not vital to any Coalition operation and could often have been provided by air. Even with the battleships, it also forced naval gun platforms to enter minefields, and face a threat from anti-ship missiles and aircraft.

This experience seems to argue for missile weapons system with greater stand-off range. Yet, other wars may involve more fighting along coasts or in ports and not be covered by minefields. The Coalition might also have been far more dependent on naval gunfire if it had had to carry out amphibious operations, or if it had not had over five months to develop its air strength. The key question for the future will be the range-

payload-lethality-cost trade-offs between ship based systems and air or land-based systems. Unfortunately, the last twilight of the battleship, while historically interesting, says little about the future.

Amphibious Operations: Forced Deception

The Coalition initially deployed a major amphibious force during Desert Storm. Planning for an amphibious operation began in mid-August, 1990, when the first elements of the 4th Marine Expeditionary Brigade (MEB) deployed to the Gulf. During the first months of Desert Shield, amphibious forces provided the Coalition's only forced entry capability to Kuwait or Iraq. These forces built up steadily and carried out highly visible amphibious exercises in Oman in late October, and then along the eastern coast of Saudi Arabia in mid-November and December. The amphibious task force doubled again in strength after mid-January. The 5th MEB arrived from California on Amphibious Group 3, on January 12, 1991.[128]

This reinforcement provided a total of 31 amphibious ships carrying the assault echelons of both the 4th and 5th Marine Expeditionary Brigades (MEBs) and the 13th Marine Expeditionary Unit (Special Operations Capable). The amphibious task force also had five Military Sealift Command (MSC) ships, and then two Maritime Prepositioning Ships to carry its follow-on echelons. The total amphibious force had 17,095 US Marines in two regimental landing teams, equipped with tanks, anti-tank vehicles, and light armored vehicles and supported by 19 AV-8Bs and 136 helicopters. In addition to the major ships, the task force had one repair ship, 17 land craft air cushion (LCACs), 13 landing craft utility (LCUs), and 115 assault amphibian vehicles (AAVs).[129]

The combined arms assets of the landing force included eight infantry battalions, 47 M-60 tanks, 112 amphibious assault vehicles, 86 light armored vehicles, 44 155mm howitzers, eight 105mm howitzers, 100 mobile TOW systems, 80 Stinger air defense systems, and 2,271 wheeled vehicles. They also included 26 AV-8Bs, 37 AH-1, 60 CH-46Es, 22 CH-53Es, and 20 UH-1N aircraft. These embarked aircraft flew a total of 19,032 flight hours during Desert Shield and Desert Storm.[130]

Iraq reacted to this growing amphibious capability with a massive coastal defense effort. It put almost as much effort into improving its defenses of the Kuwait shoreline as it did into creating defenses along the border area. In addition to mining areas near the shore, it emplaced obstacles and barbed wire to trap and disable landing craft. It put additional mines and barbed wire between the high and low water marks to trap advancing infantry. Trenches and bunkers were placed behind this positions, and berms, minefields, antitank ditches, dug-in tanks, and barbed wire blocked the exists from the beaches. Iraqi troops

fortified buildings near the shoreline in the urban areas from Ash Shuaybah through Kuwait City. Artillery fire points and reserve posts were set up to the rear, and at least three Iraqi infantry divisions were deployed along the coast from the Kuwaiti-Saudi border to Kuwait City, with the 5th Mechanized Division in reserve near Al-Ahmadi. Additional infantry divisions were deployed north of Kuwait City. Defenses were set up on Bubiyan Island, and Iraqi Marines were deployed to defend Faylaka Island.

Planning for a Major Amphibious Landing

The steady growth of Iraqi coastal defense capabilities pinned down a number of Iraqi divisions on the coast, but it also created a growing challenge to the Coalition's amphibious capabilities in spite of the expansion of the task force. As a result, a shift took place in planning that stressed the use of the task force in a deception operation designed to mislead the Iraqis into concentrating on the defense of the coast and the Kuwaiti-Saudi border. The amphibious exercise in mid-November was already designed to support the deception operation, but MARCENT was also concerned that moving the main thrust of the 1st Marine Division 50 miles to the east of the coast might create problems for the advancing Arab forces and still require an amphibious landing.

A conference on the role of the amphibious task force took place on December 30-31, 1990, and examined 10 options for amphibious operations. It concluded that the amphibious task force should continue planning to seize a logistic base along the Kuwait Coast, although it also called for raids and feints along the coast to help disguise the western movement of Coalition land forces. On January 6, USNAVCENT issued orders to the amphibious task force to prepare plans for an amphibious landing north of Ash Shuaybah that would seize port facilities at Ash Shuaybah, pin down the Iraqi forces on the coast, and destroy the Iraqi forces in the landing area. The amphibious landing was to take place four days after the ground campaign began, and the initial landing was to take place north of the Ash Shuaybah refinery. The landing force was then to attack south to seize the port.

This plan presented two special operational problems. The first was that a natural liquid gas plant existed near the port, and the Coalition was unwilling to attack near this plant because of the potential damage to Kuwait's infrastructure. The second was a row of high rise apartments and condominiums that the Iraqis had partly fortified, and the Coalition command did not want to attack Kuwait civilian residences.

Exercises revealed additional problems in coordinating amphibious task force operations into the air campaign plan, in ensuring suitable air support, in defining the objective area to ensure a useful link-up with advancing land forces, and in coordinating artillery fire. This experience led to the creation of a joint US Navy and USMC planning

staff on the USNAVCENT flag ship *USS Blue Ridge*, and the creation of a special amphibious task force targeting cell -- again illustrating the importance of improved joint or combined operations.

The amphibious task force encountered still further problems because the US lacked adequate amphibious lift assets. While the US theoretically had the necessary pool of ships, some amphibious ships had to be kept in other crisis areas. As a result, the US did not have enough ships to load all of the assault echelons of the two MEBs, and some of the 5th MEB's assault equipment had to be loaded on Military Sealift Command (MSC) ships which were not suited for amphibious operations. The US had to violate normal loading practice, which calls for the distribution of key assets to a number of ships to reduce vulnerability, and concentrate most or all of given types of helicopter on a given ship. This loading reduced the required loading and administrative support activity, but increased the risk that damage to a single ship could affect the landing. It also increased the mine warfare risk to the operation when one of the key ships in the task force had to be reassigned to mine warfare operations.

The US encountered other problems, some of which were the product of past funding limitations on the amphibious and vertical lift capabilities of the Marine Corps, and the product of the special conditions of Desert Storm:

- One problem was an initial lack of specialized amphibious support assets. The US Marine Corps was using its Maritime Prepositioning Ships (MPS) to deploy land forces for the 1st and 2nd Marine Divisions. As a result, it initially was forced to use support ships which were not adequate for amphibious warfare. The assault follow-on echelon (AFOE) of the task force was loaded on five MSC ships, none of which had been designed for amphibious operations. These ships had limited ability to unload in ways that could provide an efficient and continuous stream of equipment, and little to no capability to provide logistics over the shore operations. Two required pier cranes to off load because their on-ship cranes were inadequate, and it was clear from the start that it might take days before the Kuwaiti port could be made usable. Exercises showed that these problems were so serious that the MSC ships were off loaded in November, and were replaced by two Maritime Prepositioning Ships (MPS) with specially designed roll-on roll-off and in-stream unloading capabilities. The US Marine Corps concluded after the war that it had a requirement for a minimum of one additional MPS ship per brigade but never made this a formal force requirement because it was clear that such ships would not be funded.[131]

- o The severe limitations in theater intelligence assets discussed earlier led to a growing problem because intelligence assets were being concentrated on preparation for the land battle, and adequate intelligence support was not available for the amphibious task force.[132]
- o The Marine Corps specialized engineering equipment was concentrated in the 1st and 2nd Marine Divisions on shore, and inadequate equipment was available for clearing mines and ensuring that the AAVs could safely reach the shore. This also limited the size of the initial assault waves charged with clearing the beaches.
- o The Marine Corps could not substitute enough heliborne assets for a direct assault on the beaches because its aging CH-46 medium lift helicopters had inadequate lift, and lacked the range to allow the task force ships to operate from outside heavily mined areas.[133] The Marine Corps had recognized this lift problem as a serious weakness in its amphibious capabilities more than a decade earlier, but the long debate over replacing the CH-46 within the Department of Defense, and over the development of the V-22 VSTOL lift aircraft, had meant that no action had been taken to correct the problem.[134]
- o The Marine Corps had considered conducting an over-the-horizon heliborne assault using its longer range CH-53E helicopters, and its 13th Marine Expeditionary Unit (Special Operations Capable) had regularly practiced such operations. Such an assault had the advantage that the Iraqis would have no warning or time to prepare. On January, 1991, the 4th MEB used such a technique to evacuate US citizens from Mogadishu, operating from the *USS Trenton* at ranges of 466 miles. However, the Marine Corps only had enough CH-53 and CH-53E assets to lift one battalion, although its 17 LCACs could lift another battalion and the unit's tanks and LAVs over many of the obstacles. This gave the Marine Corps a considerable ability to conduct a major over-the-horizon raid, with supporting raids in other areas, but it did not provide enough capability for a full-scale assault. Such a raid also required substantial air support to destroy beach defenses and shape landing zones, and it was not clear whether such air support could be diverted from the land battle or function effectively if weather problems occurred. Once again, this experience illustrated the need for added medium and long range airlift capability.
- o Regardless of the initial method of assault, task force planners estimated that it would take 10 days of concentrated mine countermeasure effort to clear a path through the Iraqi minefields, and 3-5 days of naval gun fire support and air strikes to neutralize Iraqi beach defenses. The task force would also use air strikes and naval gun fire to provide support while it cleared mines inside the range of Iraqi artillery.

Without such a mine countermeasure effort the task force ships had to remain 72 miles off the coast.

- o As time went on, the requirement for a landing to establish a sea-based logistic supply point sharply declined. Stock piles built-up on land, the amount of combat engineering and logistic equipment in theater improved, and the Navy Seebees and USMC support units made major improvements in the roads and supply net which the 1st and 2nd Marine Divisions had available south of the Kuwaiti border.
- o No matter how the amphibious assault was designed, it presented the problem that pre-assault strikes would destroy a great deal of Kuwaiti housing and infrastructure, while presenting higher risks for the amphibious forces than would occur for any of the forces attacking by land.[135]

The Shift to Raids and Deception

This complex mix of problems and operational challenges had a growing impact on USCENTCOM planning. When the amphibious task force conducted Exercise Sea Soldier IV in Oman in January, USCENTCOM began to emphasize using the amphibious threat as part of its deception effort. The 13th MEU (SOC) also raided Umm Al-Maradim Island off the southern coast of Kuwait on January 29, 1991 -- although it found the island to be empty with abandoned Iraqi equipment.[136]

By the time that USCINCENT, USMARCENT, and USNAVCENT met on the *USS Blue Ridge* to review the amphibious option on February 2, 1991, it was also clear that US and allied capabilities had built-up to the point where there was no longer a need for an amphibious landing. As a result, General Schwarzkopf decided against including an amphibious landing in the initial ground attack, although he directed that it be preserved as an option that could coincide with the advance of the I MEF, and be launched on short warning.[137]

The order to maintain the option to seize a port was reiterated on February 8, 1991, but planning for the amphibious task force began to shift its focus towards conducting more feints and raids, rather than a major landing. Possible targets included the Faw Peninsula and the Falayka Island, where intelligence indicated that Iraq had deployed a 2,500 man brigade. The order to prepare for a raid on Falayka was given priority. Orders for the raid were issued on February 6, plans were completed during February 11-13, and a rehearsal was held on February 15. On February 18, however, the *USS Tripoli* and the *USS Princeton* struck mines, and it became clear that much of the planning for amphibious operations was based on faulty intelligence about Iraqi minefields. The raid was scaled back on February 22, and called off on February 23.

At that point, amphibious planning began to concentrate solely on reinforcing the deception effort.[138] On February 24, USNAVCENT ordered the amphibious task force to conduct a demonstration or feint near Ash Suaybah. By then Coalition forces were advancing rapidly into Kuwait and it became essential to keep Iraqi forces pinned down on the coast. At 0300, the Missouri began naval gunfire in the area around possible land beaches, the 13th MEU(SOC) conspicuously launched CH-53E helicopters from the USS *Okinawa*, flew towards Al-Fintas, and then turned away three miles from the beach.

In the early morning darkness on the 25th, ten USMC helicopters, some carrying electronic warfare transmitters, made a similar feint off the coast of Ash Shuaybah, while the *USS Portland* maneuvered offshore. It was at this point that the *HMS Gloucester* shot down a Silkworm missile and another landed in the water.[139]

More feints occurred near Al-Faw and Faylaka near noon on February 25, to try to pin down Iraqi forces, helicopters, and EW aircraft, while A-6Es carried out a feint near Bubiyan on the night of the 26th. A-6Es attacked the Iraqi defenses that reacted to the feint, while a smaller USMC helicopter force flew near Faylaka firing guns.

It is unclear, however, that the feints after February 24 served any real purpose in influencing Iraqi behavior at the command level. Iraqi forces were already defeated and retreating. The feints may, however, have encouraged the slow and indecisive reaction that the Iraqi commanders in the KTO had to withdrawing their forces on February 25. In any case, the amphibious option lost its remaining contingency value. The 5th MEB began landing to assume the mission of acting as the I MEF reserve on February 24. Some 7,500 men disembarked through Al-Mishab and Al-Jubayl, and assisted in mopping up, enemy prisoner of war, and security duties. USMC AV-8Bs and AH-1W helicopters began operations in support of the I MEF advance on the land, and six AV-8Bs deployed off the *USS Tarawa* to a forward airfield at Tanajib.[140]

Lessons for Amphibious Warfare

Desert Storm made good use of amphibious capabilities to achieve strategic ends in shaping the battlefield and Iraqi deployments, and succeeded in using deception, but it did not test US amphibious capabilities in a large scale landing. Unlike some 59 other contingencies since 1945, the US Marine Corps faced an enemy that was able to predict the approximate area for a landing and mine and fortify it. At the same time, the Coalition was able to build up its land based strength to the point where US commanders were unwilling to take risks with amphibious forces they might well have taken a few months earlier or in other conflicts.

Desert Storm also demonstrated the value of amphibious forces in providing contingency capabilities and supporting deception. The experience of amphibious forces

also demonstrated the need for improved USN mine countermeasures, and improved USMC airlift and amphibious ships. It helped lead the US Navy to shift towards a new emphasis on amphibious operations, to give control of the battle space priority over sea control, and to greatly increase its cooperation with the USMC planning and exercises.

At a broader level, preparing for an amphibious invasion forced a new level of cooperation between the US Navy and the US Marine Corps. It was a major factor that led both services to cooperate in developing their new littoral warfare strategy called "From the Sea." Their experience revealed a long list of problems that led both services to improve their operational plans to support the AirLand battle, and helped focus them on the need to develop a true joint concept for AirLand-naval-amphibious warfare with the Army and Air Force.[141]

Strategic Lift and the Critical Role of Sealift

All forms of strategic lift proved critical to the Coalition's success during Desert Storm. The US alone airlifted 544,000 tons of cargo, and 500,000 passengers into the theater during Desert Shield and Desert Storm, -- which required 94% of its 126 C-5s at peak periods, 73% of its 265 C-141s, extensive charters, and about 25 missions per day from its Civil Reserve Air Fleet.[142] Airlift, however, supplied only a limited amount of US logistic and sustainment needs. During Desert Shield, sealift delivered nearly 1.2 tons of cargo and 3.5 million tons of fuel.[143] These trends are illustrated in Table 10.4.[144]

Sealift was the key to effective deployment and sustainment for Britain, France, Egypt, and the United States. The US alone eventually used a total of 385 ships -- including 24 afloat prepositioning ships, eight fast sealift ships, 71 ships from its ready reserve forces (RRF), 73 US flagged or controlled cargo and tanker ships, and 210 foreign flag cargo and tanker ships.[145] During Desert Storm, an average of 4,700 tons of cargo arrived in theater daily. Sealift was able to deliver this cargo, although the average one-way voyage for ships coming from the US was 8,700 miles.[146] This experience highlighted a long-standing lesson of seapower -- that fast naval strategic mobility is as critical an element of seapower as any other element of combat arms.

The afloat prepositioning force was particularly effective. The US first used the Near-Term Propositioning Force that it had established in Diego Garcia in the 1980s, which had four ships stocked to support USCENTCOM contingencies. These ships were "indispensable" in providing critical supplies during the first days of Desert Shield. The bulk of the equipment for the first arriving ground forces -- the 7th Marine Expeditionary Brigade, and the 82nd Airborne Division could be moved using such ships. The US went on to use a total of 13 Marine MPS ships, eight Army and USAF PREPO ships, and three

PREPO tankers. This force delivered all of its initial cargoes and proved capable of meeting its goals -- in spite of the fact that three MPS ships were out of position when they were ordered to proceed to the Gulf on August 7, 1990, because of regularly scheduled maintenance and training exercises. The afloat prepositioning force then reverted to common user status, and provided continuing sealift.[147]

The value of maritime prepositioning and forward deployment is one of the lessons of the Gulf War. The MPS ships were particularly useful because they could provide some maintenance and support functions, and helped compensate for the major shortfalls in logistic and maintenance capabilities in theater early in Desert Shield. They were so effective that the Marine Corps concluded that it needed one more MPS ship per brigade after the war -- although this requirement was not funded. The US Army concluded that it needed to be able to preposition at least one heavy brigade afloat -- following the example set by the Marine Corps -- and this requirement has been funded.[148] The Chairman of the Joint Chiefs, General Colin Powell, also concluded in his 1992 report on roles and missions that the US could down-size its munitions reserve requirements, and still meet its contingency requirements far more effectively, if it moved many of its munitions stocks to prepositioning -- although this requirement too has not been fully funded.[149]

The eight US fast sealift ships met many of their goals, and delivered 13% of all cargo -- although they were only four percent of the ships used. Their speed, large size, and special configuration to suit military cargo proved to be of critical value. They did, however, present problems in speed and reliability. They operated at 27 knots during their first voyage, and at 24 knots in following voyages. This was well below their mission design speed of 33 knots, but reduced the risk of breakdowns.

The one major problem in FSS ship operations occurred as the result of a calculated risk. The *FSS Antares* had been scheduled to begin 90 days worth of maintenance when Desert Shield began. It was loaded anyway and sent to the Gulf, but a boiler breakdown forced it to be put into Rota, and its cargo had to be transferred to the *FSS Altair*. This one breakdown delayed the arrival of the initial wave of cargo by 13% and illustrated the need for more rapid sealift force to meet regional contingencies.[150] The US Navy concluded after the war that efforts to emphasize the speed of its fast sealift ships, rather than provide reliable high capacity lift at normal speeds, presented more problems than the speed was worth. It did not seek high speed as a requirement in the new ships that it procured after the war, and emphasized roll-on roll-off capabilities instead.[151]

The Ready Reserve Force (RRF) ships carried the largest percentage of dry cargo, and began arriving in theater on September 7, 1990, but they experienced a number of problems. RRF activation orders started on August 10, with the order to activate 17 roll-on

and roll-off ships and one general cargo ship. A total of 44 ships were activated during the first phase of the sealift effort, and a total of 27 more once the decision was taken to reinforce US land and air forces for a major land offensive. However, only 18 of the 71 activations were on time. Ships with scheduled breakout times of 5 and 10 days took 11-16 days to break out. A total of 32 ships were late or failed to activate in phase one, and 24 of these had serious mechanical failures. Six ships had short delays because crew members and shipyard workers were not available. In general, the RRF force presented problems in terms of aging ships with obsolete systems, a lack of trained crew for older ship types, and a lack of roll-on and roll-off ships that seriously restricted the range of cargo that could be carried.[152]

Chartering ships, including foreign ships, worked well in spite of long-standing fears about the need for US flag or US controlled vessels. The US used 25 US flagged or controlled cargo ships, 47 US flagged or controlled cargo ships, 187 foreign flagged cargo ships, and 23 foreign flagged tankers. Chartering tankers was particularly important because the US Military Sealift Command had to double its tanker fleet to meet even one major regional contingency. Foreign charters under foreign control proved to be as responsive as US flag or US controlled vessels, and the US had to turn to foreign flag vessels for most of its charters to meet the need for vessels that could carry the standard 40 foot containers used for most sustainment cargo, and more roll-on and roll-off ships. Such charters were a fraction of the cost of RRF ships (including activating, operating, and deactivating RRF ships), and helped meet the need to delivery 1,200-2,000 containers per week.[153]

The US was also able to speed up the shipment of containers from the US to Saudi Arabia from a normal time of 30-35 days to 25-27 days by breaking with the traditional reliance on single voyages, and using large container vessels to ship to the Mediterranean, where the containers were interlined from the large vessels to smaller ones which then moved quickly to the Gulf. This system demonstrated the flexibility possible in using commercial charters, regardless of flag, when secure sea lanes exist to a theater of combat.

The Coalition was dependent on a wide range of seaports in Bahrain, Oman, Saudi Arabia, Qatar, and the UAE. The seven seaports in Saudi Arabia were particularly critical. Saudi Arabia has four ports on the Gulf and three on the Red Sea, and these took 70% of the total throughout of cargo for Desert Shield and Desert Storm. Ad Dammam and Al-Jubayal were particularly important because they had the heavy lift equipment, warehouses, hardstand outdoor storage, staging areas, and road networks to allow rapid off-loading and deployment during both Desert Shield and Desert Storm. This dependence on seaports reinforced the need for sea control in the Gulf and Red Sea.[154]

These lessons about the importance of strategic sealift have led the US to consider purchasing twenty new roll-on roll-off ships of a new medium speed type that can handle tanks and tracked vehicles. If they are fully funded, 11 of these 20 ships will be kept at high readiness at US ports, along with the eight SL-7 fast sealift ships used during the Gulf War. The total capacity of this 19 ship sealift force would be two US Army divisions, plus support equipment. The other nine roll-on roll-off ships and two newly leased container ships would be used for afloat prepositioning. Loaded with the gear for a US Army heavy brigade, these ships could be anchored near a base like Diego Garcia, and would supplement the total of 21 afloat prepositioning ships the US already has in serve.[155] Further, the US is seeking to modernize the RRF by buying 64 ships from commercial sources, and to expand the RRF from 96 to 142 ships. Full modernization of the RRF now seems uncertain, but the US did buy 12 additional roll-on roll-off ships by 1993, and is bringing them up to US standards in US shipyards.[156]

The Gulf War also illustrated the need for better US Army planning for the use of dedicated sealift that involved careful detailed contingency planning to meet total expeditionary of the kind long carried out by the USMC. The US Army's lack of prior planning -- combined with USCENTCOM's changing force requirements -- created as many real-world movement plans as the availability of adequate sealift. So did the fact that the US Transportation Command did not have a detailed mobilization plan to shift to support of a major war, had significant information and data processing problems, and a lack of adequate ports, port facilities, and railheads in the US.[157] The movement of the 24th Mechanized Division on August 11 revealed serious problems with the choice of port, tides, berth space, and ramp angles that should have been solved years earlier. The Army experienced serious problems because it had not properly prepared its equipment to move to ports by rail. [158]

In summary, the Gulf War demonstrated the need for rapid maritime power projection capability for any power seeking to play a major role outside its own region. This is scarcely a new lesson for the US, but it is one that has been given new emphasis. It helped trigger the US Department of the Defense's emphasis on additional sealift in its Bottom Up Review, and the US Navy's new emphasis on using sealift and seapower to support expeditionary forces from all four services in its post-Cold War strategy power, "From the Sea." That paper states,[159]

> "America's influence depends on its ability to sustain military operations around the globe. The military options available can be extended indefinitely because sea-based forces can remain on station as long as required. Naval forces encompass the full range of logistics support that is the critical element of any

military operation....It requires open sea lanes of communication so that passage of shipping is not impeded by an adversary...during war, strategic sealift ships will deliver heavy equipment and resupply heavy air and ground forces, Forward logistics, prepositioning, and strategic sealift, coupled with strategic airlift, are the keys to force sustainment."

Table 10.4

US Strategic Sealift and Airlift During the Gulf War

Total US Lift

Date	Airlift			Sealift			
	Missions	Cargo (tons)	Troops	Voyages	Cargo (Stons)	Fuel (Stons)	Troops
1980							
August	1,668	46,945	67,263	21	253,293	333,640	315
September	1,873	68,880	60,476	37	252,013	508,534	681
October	1,421	52,295	51,154	71	433,708	517,038	436
November	1,502	43,926	20,553	36	264,489	1,1011,243	186
December	2,737	90,587	105,413	70	447,517	894,061	465
1991							
January	3,272	118,144	132,095	149	910,379	1,088,825	516
February	3,052	95,509	45,562	68	527,322	1,336,807	147
March	2,531	40,013	10,963	14	301,426	412,855	30
Total	18,056	556,299	493,499	466	3,390,147	6,103,003	2,776

Source: GAO, "Desert Shield/Desert Storm: US Transportation Command's Support of Operation," Washington, GAO/NSIAD-92-54, January, 1992, pp. 5-10, and Association of the US Army, "Special Report: Operations Desert Shield and Desert Storm, The Logistics Perspective, Arlington, Association of the US Army, September, 1991.

Lessons For Coalition Warfare And International Peace Making.

The Coalition's advantages in many aspects of naval warfare were so great that it is sometimes easy to forget their importance. Desert Shield would have been a very different operation if the US Navy had not been able to rush in carrier task forces, advanced naval air assets, air and missile defense ships, and advanced command and control ships, and if the advanced air/missile defense and mine countermeasure capabilities of the Royal Navy had not been committed to combat areas.

Sea control and control of the battlefield area were critical since the UN sanctions and embargo would have been meaningless without them. Coalition naval capabilities to secure Saudi and southern Gulf ports played a critical role in the land-air build-up since 95% of all wartime equipment and supplies brought into the theater moved by sea.

Seapower played a critical role in providing Coalition air power to help deter Iraqi attacks on Saudi Arabia, and prevent Iraqi missile and mine warfare ships from raiding deep into the Gulf. Coalition naval capabilities, used for securing Saudi and southern Gulf ports, played a critical role in the land-air build-up.

The Coalition's decisive air victory was heavily dependent on US Navy and US Marine Corps aircraft. US amphibious forces tied down a major part of Iraq's land forces, and greatly eased the task of penetrating Iraq's forward defenses, while limiting its ability to extend its defenses further West. Allied mine warfare forces played a major role in limiting Iraq's mine warfare capabilities, and joint cooperative operations by Coalition forces were critical to hunting down and destroying Iraq's surface forces.

The fact that seapower won a relatively quiet victory compared to the air and land battles does not make it less strategically important or critical to future operations. It is also impossible -- if not foolish -- to try to draw lessons about the relative importance of seapower, land or sea-based air power, and amphibious and regular land forces from the Gulf War. Future wars and peacekeeping operations offer no guarantee that war will take place against such weak naval forces, that secure ports and major land-based air bases will be available, that there will be five and one-half months to deploy regular land forces and bring land based air forces to full effectiveness, or that enemy mining and anti-ship activity will be as limited in scope and aggressiveness.

Seapower is a critical element of both joint and cooperative warfare, whose relative importance -- like all elements of military power -- is dependent on the specific contingency. Jointness, cooperative security, and decisive force won the Gulf War, not the individual contributions by air power, land power, or sea power. At the same time, power projection can never be secure, and will rarely be effective, without the support of decisive seapower. This is the critical lesson for the future, and it is one that efforts to make precise trade-offs between different kinds of military power ignores. Strength and flexibility are the only substitutes for prophecy, and the gift of prophecy very definitely is *not* a lesson of modern war.

At the same time, the Gulf War provided an important lesson for the US by showing that its seapower and naval air requirements had changed fundamentally with the end of the Cold War. The Gulf War showed the need for a Navy focused on the support of US power projection in major regional contingencies and in littoral warfare. It showed the need to shift away from planning to defeat the Soviet Navy, to the support of the Marine Corps, US Army, and USAF in the AirLand battle. It also showed the need for the US Navy and USMC to plan for mid and high intensity warfare, and not simply for low intensity and amphibious warfare.[160]

This shift in strategy and force planning became a central focus of both the US Navy and USMC planning in September, 1992 when both services jointly issued the white paper called "From The Sea." It is now embodied in US force plans and is a major lesson of the Gulf War. What is less clear is that the US Navy is acquiring the air and missile capabilities to fully support a major land battle, or that the USMC has the resources to obtain the amphibious and theater lift it needs, or the armor and artillery that it may require in future major regional contingencies. There is no substitute for such US naval power. While other navies, particularly the British Navy, can bring major assets to the battle, they cannot conduct major naval air, ship-to-surface missile, or amphibious operations.

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[1] The analysis in this section is based primarily on interviews, The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 13-15, 249-309 and Annex T; Commodore C. J. S. Craig, "Gulf War: The Maritime Campaign," RUSI Journal, August, 1992, pp. 11-16.; Letter to Senator Edward Kennedy from General C.E. Mundy, Commandant of the US Marine Corps, dated June 11, 1993 (1000 CMC), and Vice Admiral Stanley A. Arthur and Marvin Pokrant, "Desert Storm at Sea," Proceedings, May, 1991, pp. 82-86; General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991; James E. Dunnigan, High Tech Weapons, Military Strategy and Coalition Warfare in the Persian Gulf from Shield to Storm, New York, William Monroe & Co., 1992, pp. 307-341; Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 125-147; Norman Friedman, Desert Victory: The War for Kuwait, Annapolis, Naval Institute Press, 1991; B. L. Cyr, Bruce Watson, R Lurghai, Bruce George, T. Lister, and J. Pirou, "Naval Operations," in Bruce Watson (ed.), Military Lessons of the Gulf War, London, Greenhill, 1991; Captain, J.H. Patton, "More Gulf War Lessons," Proceedings, April, 1991, p. 52; The Shield and the Storm: Naval and Marine Corps Aviation in the Gulf War, Association of Naval Aviation, Falls Church, Virginia, 1991.

[2] General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, p. 6.

[3] Sealift is discussed in more depth in Chapter 11. It moved a total of 2.4 million tons of cargo during Desert Shield, which is more than four times than amount moved during the invasion of Normandy and 6.5 times the amount needed for the peak build-up in Vietnam. The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 13-14, 28.

[4] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 13-15. For details of the history of the US Navy in the Gulf before Desert Shield and the build-up during Desert Shield, see The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 2-17; a detailed chronology of the build-up of US Navy forces is provided in pp. A-2 to A-14.

[5] The details of the build-up of allied forces can be found in The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, Annex C. Total allied strength is shown and discussed in Chapter 3.

[6] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 261-262.

[7] Figures provided by US Navy Congressional Liaison, June, 1991. Totals are rounded.

[8] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 36-37, A-15, and Annex D; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 261-262; General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, pp. 11-15.

[9] Captain Vincent P. Thomas, The Sea Services' Role in Desert Storm, September, 1991, pp. 28-29.

[10] Armed Forces Journal, February, 1992, p. 44.

[11] Letter to Senator Edward Kennedy from General C.E. Mundy, Commandant of the US Marine Corps, dated June 11, 1993 (1000 CMC).

[12] For a more detailed discussion of many of these issues, see Chapter Five and James A Winnefield and Dana J. Johnson, Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991, pp. 111-117

[13] There are many US Navy briefing papers explaining these changes, beginning with "From the Sea." One of the first to translate the new doctrine into specific force concepts is

Rear Admiral Philip Quast, USN, Surface Warfare Division, and Major General Harry Jenkins, Jr., USMC, Expeditionary Forces Division, "Joint Littoral Warfare Assessment, New Directions and New Force Structures...From the Sea With Vision," Washington, US Navy, June, 1993.

[14] Jane's Defense Weekly, April 13, 199`, p. 586.

[15] For a more detailed discussion of many of these issues, see Chapter Five and James A Winnefield and Dana J. Johnson, Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991, pp. 111-117; Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 136.

[16] Defense News, August 19, 1991, p. 10.

[17] Jane's Defense Weekly, April 13, 1991, pp. 579 and 586.

[18] Jane's Defense Weekly, April 13, 1991, pp. 579 and 586.

[19] All such range data are highly nominal and controversial. These data are taken from Armed Forces Journal, February, 1992, p. 44.

[20] A point raised by Rear Admiral William Hancock, the former commander of the first carrier battle group to use the F/A-18 in the strike role. See Seattle Post-Intelligencer, July 19, 1994, p. 1.

[21] Interviews, Rear Admiral R. D. Mixson, Director of Air Warfare, "Budgetary Impacts on Joint Strike Planning," Director, Air Warfare, US Navy, June, 1993 -- briefing slides; Jane's Defense Weekly, April 9, 1991, p. 9.

[22] For a more detailed discussion of many of these issues, see Chapter Five and James A Winnefield and Dana J. Johnson, Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991, pp. 111-117; Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 136.

[23] See Letter to Senator Edward Kennedy from General C.E. Mundy, Commandant of the US Marine Corps, dated June 11, 1993 (1000 CMC), and Vice Admiral Stanley A. Arthur and Marvin Pokrant, "Desert Storm at Sea," Proceedings, May, 1991, pp. 82-86; and Rear Admiral R. D. Mixson, Director of Air Warfare, "Budgetary Impacts on Joint Strike Planning," Director, Air Warfare, US Navy, June, 1993 -- briefing slides.

[24] Arnold Meisner, Desert Storm Sea War, pp. 64-64.

[25] See Rear Admiral Philip Quast, USN, Surface Warfare Division, and Major General Harry Jenkins, Jr., USMC, Expeditionary Forces Division, "Joint Littoral Warfare Assessment, New Directions and New Force Structures...From the Sea With Vision," Washington, US Navy, June, 1993.

[26] Letter to Senator Edward Kennedy from General C.E. Mundy, Commandant of the US Marine Corps, dated June 11, 1993 (1000 CMC), p. 3.

[27] Air Force Times, April 15, 1991, p. 24; Arnold Meisner, Desert Storm Sea War, pp. 64-64; Aviation Week, February 4, 1991, pp. 24-26.. Also see Letter to Senator Edward Kennedy from General C.E. Mundy, Commandant of the US Marine Corps, dated June 11, 1993 (1000 CMC), p. 3, and Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, p. 136.

[28] The unclassified outline of this plan is funded in Rear Admiral W. E. Jordan, Joint SEW/Intelligence Assessment, US Navy, June, 1993 -- briefing slides.

[29] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. A-19 to A-20. There is a quiet debate in the Navy over whether this shoot down occurred because an E-2C that was supposed to provide radar coverage in the area failed to report problems in its radar or communications system.

[30] This discussion of naval air power is based largely on the data and statistics in Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 272-274.

[31] The Shield and the Storm: Naval and Marine Corps Aviation in the Gulf War, Association of Naval Aviation, Falls Church, Virginia, 1991, p. 10.

[32] The Shield and the Storm: Naval and Marine Corps Aviation in the Gulf War, Association of Naval Aviation, Falls Church, Virginia, 1991, p. 10.

[33] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 273.

[34] Naval Aviation News, September-October, 1991, pp. 14-17.

[35] Lt. Mark D. Phillips, Tomahawk Strikes!," Surface Warfare, March/April, 1991, pp. 8-13.

[36] Technical data provided to the author by McDonnell Douglas, and Eliot Cohen, Editor, Gulf War Air Power Survey, Volume IV, pp. 77, 171, 242, 248-249, and Defense News, July 5, 1993, p. 18..

[37] See Commander Steve Froggett, "Tomahawk in the Desert," Proceedings, January, 1992, pp. 71-75, and Defense News, July 5, 1991, p. 18 and Eric H. Arnett, "Awestruck Press does Tomahawk PR," Bulletin of the Atomic Scientists, April, 1991, pp. 7-10.

[38] Technical data provided to the author by McDonnell Douglas, and Eliot Cohen, Editor, Gulf War Air Power Survey, Volume IV, pp. 77, 171, 242, 248-249.

[39] Aviation Week, January 21, 1991, p. 61.

[40] For a good description of this mission, see Arnold Meisner, Desert Storm Sea War, London, The Power Series,, 1991, pp. 49-54. Meisner indicates that the *San Jacinto* was loaded with 122 Tomahawks on August 15, 1991.

[41] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 35.

[42] Eliot Cohen, Editor, Gulf War Air Power Survey, Volume IV, pp. 249-252.

[43] Commander Steve Froggett, "Tomahawk in the Desert," Proceedings, January, 1992, pp. 71-75. This article provides a graph showing the rate of TLAM firings versus naval air attack missiles. Also see Lt. Mark D. Phillips, Tomahawk Strikes!," Surface Warfare, March/April, 1991, pp. 8-13; Aviation Week, January 21, 1991, p. 61, January 28, 1991, pp. 29-30; Defense Daily, May 10, 1991, p. 240; Jane's Defense Weekly, January 26, 1991, p. 106 and February 2, 1991, p. 133; Insight, February 11, 1991, p. 48.

[44]. Eliot Cohen, Editor, Gulf War Air Power Survey, Volume IV, pp. 249-252.

[45] Aviation Week, April 27, 1992, pp. 18-19

[46] For a contemporary description of US Navy launch activity see Lt. Mark D. Phillips, "Tomahawk Strikes!," Surface Warfare, March/April, 1991, pp. 8-13.

[47] For an example of the 85% hit rate claim see Office of the Chief of Naval Operations, The United States Navy in Desert Shield/Desert Storm, Washington, Department of the Navy, 00/1U500179, May 15, 1991, p. 47, which claims that 85% of 288 missiles fired hit their targets. The corrected figures shown here are based on interviews with CNA personnel aware of the study performed for the CNO of cruise missile effectiveness which has never been publicly released.

[48] Interviews and reports on the CNA study and other corrections to the initial data on the Tomahawk. See Defense News, January 24, 1994, p. 1; Washington Post, April 10, 1992, p. A-1, for typical reporting. Interviews raise significant questions about the definition of "hit" in post-war studies, and whether it was properly related to any reasonable expectation of damage effects.

[49] Department of Defense, Conduct of the Persian Gulf War: Final Report, p. T-201.

[50] Defense Daily, May 10, p. 240.

[51] Department of Defense, Conduct of the Persian Gulf War: Final Report, pp. T-201 to T-202.

[52] For more balanced criticism see Eric H. Arnett, "Awestruck Press does Tomahawk PR," Bulletin of the Atomic Scientists, April, 1991, pp. 7-10; Washington Post, April 10, 1992, p. A-1; and Defense News, November 1, 1993, p. 3, January 24, 1994, p. 1.

[53] Washington Times, November 17, 1993, p. A-13; Aviation Week, July 5, 1993, p. 26, Defense News, January 24, 1994, p. 1; Washington Post, April 10, 1992, p. A-1.

[54] US Navy Congressional Liaison briefing papers of January, 1993 and July, 1993; McDonnell Douglas, Aviation Week, January 28, 1991, p. 30; Defense News, June 25, 1991, p. 8;

[55] See the excellent discussion of Tomahawk mission planning issues in Commander Steve Froggett, "Tomahawk in the Desert," Proceedings, January, 1992, pp. 71-75. Also see Aviation Week, January 28, 1991, p. 30; Defense News, June 25, 1991, p. 8, November 1, 1993, p. 3.

[56] See the excellent discussion of Tomahawk mission planning issues in Commander Steve Froggett, "Tomahawk in the Desert," Proceedings, January, 1992, pp. 71-75. Also see Aviation Week, January 28, 1991, p. 30; Defense News, June 25, 1991, p. 8, November 1, 1993, p. 3.

[57] Defense News, May 9, 1994, p. 3.

[58] See Office of the Chief of Naval Operations, The United States Navy in Desert Shield/Desert Storm, Washington, Department of the Navy, 00/1U500179, May 15, 1991, p. 48.

[59] The Navy had conducted 25 post-war tests by January, 1993. All performed reliably.

[60] US Navy briefing paper, "Stand-off Land Attack Missile," January, 1993.

[61] US Navy briefing paper, January, 1993, Defense News, July 29, 1991, p. 22, July 5, 1991, p. 18; Washington Times, October 22, 1991, p. A-3.

[62] Mark D. Phillips, Tomahawk Strikes!," Surface Warfare, March/April, 1991, pp. 8-13.

[63] Defense News, May 8, 1989, p. 6; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 13-15, 258-259.

[64] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 13-15, 258-259.

[65] This force was a small, but interesting example of the importance of jointness. See Frank Colucci, "Warriors at Sea," Defense Helicopter, December, 1991-February 1992, pp. 4-8.

[66] The GWS.30 is an upgraded version of the Seat Dart with an improved blast fragmentation warhead, improvements to the Type 909 tracker, and to the Type 1022 surveillance software. The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 43.

[67] Interviews.

[68] Jane's Defense Weekly, April 3, 1991, pp. 604-608; Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 126; Anthony Preston, "Naval Lessons of the Gulf War," Asian Defense, January 1992, pp. 64-67, and Anthony Preston, "Naval Aspects of the Gulf Conflict," Military Technology, 4/91, pp. 58, 60-61; Norman Friedman, Desert Victory: The War for Kuwait, Annapolis, Naval Institute Press, 1991, p 210.

[69] Thomas A. Keaney and Eliot A. Cohen, Gulf War Air Power Survey: Summary Report, , p. 101.

[70] A detailed but early chronology of surface warfare action is provided in The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, Annex H.

[71] "Storming the Rigs," Surface Warfare, March/April, 1991, pp. 14-15; The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 39-40, A-16.

[72] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 40, A-18.

[73] Analysts at the time felt the force might be preparing for an attack on the port of Ras Al-Kahji. POW data released since the war indicates that they did not carry a significant number of troops and were fleeing to Iran. Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 138-139.

[74] The Royal Navy ships were the *HMS Cardiff, HMS Gloucester*, and *HMS London*.

[75] For further details, see Lt. Commander Alan Rycroft, "Prowling the Gulf," Defense Helicopter, May-June, 1992, pp. 19-21, and Commodore C. J. S. Craig, "Gulf War: The Maritime Campaign," RUSI Journal, August, 1992, pp. 11-16.

[76] David Foxwell, Operational Lessons: Contending With Iraq's Patrol Boats," International Defense Review, 5/1991, p. 466; Jane's Defense Weekly, June 8, 1991, p. 953.

[77] Lt. Commander Alan Rycroft, "Prowling the Gulf," Defense Helicopter, May-June, 1992, pp. 20-21

[78] Anthony Preston, "Naval Aspects of the Gulf Conflict," Military Technology, 4/91, pp. 58-61; Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, p. 139.

[79] David Foxwell, Operational Lessons: Contending With Iraq's Patrol Boats," International Defense Review, 5/1991, p. 466.

[80] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 309.

[81] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 41-42, A-22 to A-23.

[82] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. A-24 to A-26.

[83] Thomas A. Keaney and Eliot A. Cohen, Gulf War Air Power Survey: Summary Report, , p. 101.

[84] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 267-268.

[85] For more detailed discussion, see Norman Friedman, Desert Victory: The War for Kuwait, Annapolis, Naval Institute Press, 1991, pp. 209-210; Anthony Preston, "Naval Aspects of the Gulf Conflict," Military Technology, 4/91, pp. 58, 60-61; Stuart Slade, "The FAC's End Approaches," NAFO, pp. 12-13 (date not indicated on copy).

[86] For more detailed discussion, see Norman Friedman, Desert Victory: The War for Kuwait, Annapolis, Naval Institute Press, 1991, pp. 209-210; Anthony Preston, "Naval Aspects of the Gulf Conflict," Military Technology, 4/91, pp. 58, 60-61; Stuart Slade, "The FAC's End Approaches," NAFO, pp. 12-13 (date not indicated on copy).

[87] For more detailed discussion, see Norman Friedman, Desert Victory: The War for Kuwait, Annapolis, Naval Institute Press, 1991, pp. 209-210; Anthony Preston, "Naval Aspects of the Gulf Conflict," Military Technology, 4/91, pp. 58, 60-61; Stuart Slade, "The FAC's End Approaches," NAFO, pp. 12-13 (date not indicated on copy).

[88] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 309.

[89] While the two corvettes were designed to have six ILAS-3 anti-submarine warfare torpedo mountings, these were not delivered.

[90] Jane's Defense Weekly, February 11, 1989, p. 205; May 29, 1989, p. 1002; , 1991-1992, p. 292; Jane's Fighting Ships, 1991-1992, pp. 292-293.

[91] This analysis of Iraqi naval strength draws heavily on US Naval Institute, The Naval Institute Guide to the Combat Fleets of the World, 1993, Their Ships, Aircraft, and Armament, Annapolis, Naval Institute, 1993; Jane's Fighting Ships, 1992-1993; IISS, The Military Balance, 1993-1994, IISS, London, 1993, pp. 115-117; USNI Data Base. Military Technology, World Defense Almanac: The Balance of Military Power, Vol. XVII, Issue 1-1993, ISSN 0722-3226, pp. 139-142.

[92] This analysis of Iraqi naval strength draws heavily on US Naval Institute, The Naval Institute Guide to the Combat Fleets of the World, 1993, Their Ships, Aircraft, and Armament, Annapolis, Naval Institute, 1993; Jane's Fighting Ships, 1992-1993; IISS, The Military Balance, 1993-1994, IISS, London, 1993, pp. 115-117; USNI Data Base. Military Technology, World Defense Almanac: The Balance of Military Power, Vol. XVII, Issue 1-1993, ISSN 0722-3226, pp. 139-142.

[93] Military Technology, 2/92, pp. 97-98.

[94] Saddam Hussein's personal navy has also been a casualty of war. One of the personal yachts that Saddam Hussein ordered before the Iran-Iraq War, the *Al Manuser* was transferred to King Fahd of Saudi Arabia in 1987, and was never even entered Iraqi waters. a second yacht, the *Al Qadissiya*, which Saddam Hussein ordered for use on Iraq's rivers has never been delivered.

[95] Saddam Hussein's personal navy has also been a casualty of war. One of the personal yachts that Saddam Hussein ordered before the Iran-Iraq War, the *Al Manuser* was transferred to King Fahd of Saudi Arabia in 1987, and was never even entered Iraqi waters. a second yacht, the *Al Qadissiya*, which Saddam Hussein ordered for use on Iraq's rivers has never been delivered.

[96] These and other army strength estimates are based upon Interviews in London, December, 1991, in Switzerland and Israel, January, 1992; Jane's Defense Weekly, February 22, 1992, p. 284; Jerusalem Post, January 25, 1992, p. 9; Washington Times, January 20, 1992, p. 10; Washington Post, November 7, 1991, p. A-46, November 14, 1991, p. A-47; Wall Street Journal, November 11, 1991, p. A-10; Jane's Defense Weekly, November 16, 1991, p. 926, February 22, 1992, pp. 284; The Estimate, November 22-December 5, 1991, p. 1; Michael Eisenstadt, "Recent Changes in Saddam's Inner Circle: Cracks in the Wall?" Policywatch, Number 22, November 22, 1991, pp. 1-2; Defense News, February 24, 1992, p. 1.

[97] Much of the discussion of the mine warfare operation is based on Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 273-286.

[98] Iraq claimed to be developing a family of eight non-magnetic bottom mines at the time of the Gulf War. Defense News, May 8, 1989, p. 6; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 13-15; James E. Dunnigan, High Tech Weapons, Military Strategy, and Coalition Warfare in the Persian Gulf War from Shield to Storm, pp. 313-317.

[99] Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, pp. 49-50.

[100] Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, p. 50.

[101] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 276.

[102] Military Technology, 4/91, p. 61.

[103] See The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, Annex A, and Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 276-282; Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, pp. 48-56, and Tamara Moser Melia, Damn the Torpedoes, A Short History of US Naval Mine Countermeasures, 1777-1991, Washington, Naval Historical Center, 1991, 91-138.

[104] Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, p. 57;.

[105] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. T-210 to T-213; Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, pp. 57; Defense Week, April 20, 1992, p. 1..

[106] Sir Peter de la Billiere, Storm Command, pp. 257-259, 271-272.

[107] This explosive ordnance disposal effort was one of the successes of the mine warfare program. For a description, see Commander R. J. Nagle, "Having A Blast in the Gulf," Proceedings, October, 1992, pp. 104-106.

[108] Andrew Lambert, "The Naval War," in John Pilott and Stephen Badsey, The Gulf War Assessed, London, Arms and Armor, 1992, pp. 140-141

[109] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 282.

[110] ; The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 42-43, A-34 to A-35; Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, p. 52-53.

[111] Reports that the *Princeton* ignored warnings from the British mine vessels to slow down and proceed with caution have never been confirmed. Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, p. 52

[112] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 42-43, A-34 to A-35; Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, p. 52-53.

[113] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 284; ; The United States Navy in "Desert Shield "Desert Storm",

Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 43-44.

[114] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 286.

[115] Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, pp. 49-50.

[116] This in no sense is a reflection on the morale and dedication of naval forces involved, and seems to have been a political decision. For a description of the Belgian effort, see Vice Admiral Josef de Wilde, "Mine Ware in the Gulf," NATO's Sixteen Nations, No. 1, 1992, pp. 9-11.

[117] James E. Dunnigan, High Tech Weapons, Military Strategy, and Coalition Warfare in the Persian Gulf War from Shield to Storm, pp. 313-317; Anthony Preston, "Allied MCM in the Gulf," Naval Forces, 4/1991, pp. 49-52.

[118] General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, p. 21.

[119] Jane's Defense Weekly, April 9, 1994, p. 27.

[120] Jane's Defense Weekly, April 9, 1994, p. 27.

[121] Statement of Admiral Frank Keels, Chief of Naval Operations, to the Senate Armed Services Committee, June 29, 1993; Defense News, April; 18, 1994, p. 4; Jane's Defense Weekly, April 9, 1994, p. 9.

[122] See US Navy Mine Warfare Command, "US Navy Mine Warfare Plan, Fiscal Year 1994-1995 Program, Washington, 1994; US Navy, "US Navy Mine Countermeasures Program, Report to Congress," Washington, US Navy, January, 1993. For background, see Captain J. M. Martine, "We Still Haven't Learned," Proceedings, July, 1991, pp. 64-68; David Foxwell, "Naval Mine Warfare: Underfunded and Underappreciated," International Defense Review, 2/1993, pp. 125-129; David Foxwell, "Mine Warfare in An Uncertain World," International Defense Review, 5/1992, pp. 425-429, and Carl White, "Shallow Water Mines - Meeting the Challenge," Amphibious Warfare Review, Summer/Fall 1992, pp. 78-84, and H. Dwight Lyons, Eleanor A. Baker, Sabrina R. Edlow and David A. Perin, "The Mine Threat: Show Stopper or Speed Bump?", Alexandria, Center for Naval Analysis (Undated).

[123] For a description of early gun support operations, see "BB's Big Guns Blast Away," Surface Warfare, March/April, 1991, pp. 16-17.

[124] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 289-293 and Annex T, pp. T-214 to T-216; The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. I-2.

[125] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 289-293. Somewhat different figures are provided in The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, Annex G.

[126] These figures are taken from the Department of Defense Conduct of the Persian Gulf War study, pp. 289-293.

[127] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, Annex G, p. G-2.

[128] This discussion draws on commentary on draft manuscript by Colonel William J. Davis, Deputy Director, History and Museums, USMC, July 19, 1994, and comments by Colonel Dennis P. Mroczkowski and Lt. Colonel Charles H. Cureton, USMC, July 16, 1994; Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 293-309; ; The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, pp. 44-45, and General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, p. 4; Captain Vincent C. Thomas, "The Sea Services' Role in Desert Shield/Desert Storm," Seapower, September, 1991, pp. 27-32, and Bernard E. Trainor, "Amphibious Operations in the Gulf, Marine Corps Gazette, August, 1994, pp. 57-60.

[129] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 297; General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, p. 6.

[130] Working brief providing by Marine Corps Legislative Liaison, June, 1991.

[131] Interview with senior Marine officer.

[132] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 298.

[133] Captain Vincent C. Thomas, "The Sea Services' Role in Desert Shield/Desert Storm," Seapower, September, 1991, pp. 27-31

[134] Interview with senior Marine officer. Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 298; General A.M. Gray, Commandant of the Marine Corps, Preliminary Report on the Lessons Learned in Operation Desert Shield and Desert Storm, Washington, Headquarters US Marine Corps, Undated document in response to Secretary of Defense letter of April 8, 1991, p. 34; Aerospace Daily, April 13, 1994, p. 67.

[135] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. 298-299.

[136] For a good discussion of command level discussion of this issue, see Molly Moore, Woman at War, New York, Scribners, 1993, pp. 116-119.

[137] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 299.

[138] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 302.

[139] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. 303.

[140] The United States Navy in "Desert Shield "Desert Storm", Washington, Department of the Navy, Office of the Chief of Naval Operations, May 15, 1991, p. 47.

[141] See Rear Admiral Philip Quast, USN, Surface Warfare Division, and Major General Harry Jenkins, Jr., USMC, Expeditionary Forces Division, "Joint Littoral Warfare Assessment, New Directions and New Force Structures...From the Sea With Vision," Washington, US Navy, June, 1993.

[142] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. F-26 to F-27.

[143] For additional data on sealift during Desert Shield, see Ronald O'Rourke, "Sealift and Operation Desert Shield," Washington, Congressional Research Service 90-446F, September 17, 1990.

[144] Department of Defense sources show a wide range of different figures for total lift. The Department of Defense, Conduct of the Persian Gulf War: Final Report, calculates that sealift provided 95% of all heavy cargo lift.

[145] Slightly different figures are used by various sources. These figures come from Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. F-34 to F-38. For additional data from a source contemporary

with the study of lessons from the Gulf War, see Lt. Commander Robin E. Rathbun, "Strategic Mobility for the 1990s: The Strategic Mobility Requirements Study," Strategic Review, Summer, 1992, pp. 48-56.

[146] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. F-33 to F-34.

[147] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. F-37.

[148] Dr. William J. Perry, "Department of Defense, FY1995 Budget," Washington, Department of Defense, February 7, 1994; Secretary of Defense Les Aspin, "The Bottom Up Review: Forces for a New Era," Washington, OSD, September 1, 1993, pp. 9, 11-12; Chairman of the Joint Chiefs of Staff, "Report on the Roles, Missions, and Functions of the Armed Forces of the United States," Washington, Office of the CJCS, February, 1993, pp. II-6 to II-7 and II-10 to II-11; General Ronald R. Fogleman, Commander in Chief, US Transportation Command, "Defense Transportation in a Changing World," Statement to the Senate Armed Services Committee, April 22, 1993, pp. 9-10.

[149] This requirement was laid out more clearly in the working draft of the report, but is still touched upon in Chairman of the Joint Chiefs of Staff, "Report on the Roles, Missions, and Functions of the Armed Forces of the United States," Washington, Office of the CJCS, February, 1993, pp. II-6 to II-7 and II-10 to II-11. For further details on maritime prepositioning during the war, see Colonel William H. Harris, "MPF Reconstitution," Marine Corps Gazette, November, 1991, pp. 34-41.

[150] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. F-35.

[151] See the exchange between Vice Admiral Francis R. Donovon, then commander of the Military Sealift Command and Congressman Norman Sisisky reported in Armed Forces Journal, April, 1991, p. 12.

[152] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. F-35 to F-36. There are many good descriptions of the problems in the RRF and US merchant marine. For a good summary contemporary with the Gulf War, see Carol Matlock, "Barely Afloat," National Journal, April 27, 1991, pp. 988-991.

[153] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, pp. F-36 to F-37.

[154] Department of Defense, Conduct of the Persian Gulf War: Final Report, Department of Defense, April, 1992, p. F-14.

[155] Dr. William J. Perry, "Department of Defense, FY1995 Budget," Washington, Department of Defense, February 7, 1994; Secretary of Defense Les Aspin, "The Bottom Up Review: Forces for a New Era," Washington, OSD, September 1, 1993, pp. 9, 11-12; Chairman of the Joint Chiefs of Staff, "Report on the Roles, Missions, and Functions of the Armed Forces of the United States," Washington, Office of the CJCS, February, 1993, pp. II-6 to II-7 and II-10 to II-11; General Ronald R. Fogleman, Commander in Chief, US Transportation Command, "Defense Transportation in a Changing World," Statement to the Senate Armed Services Committee, April 22, 1993, pp. 9-10; Rear Admiral Jim Greene, Assistant Deputy CNO Logistics, "Strategic Sealift Program, US Navy briefing aids, May 7, 1993.

[156] Peter Grier, "The Ton-Mile Gap," Air Force, November, 1992, pp. 30-33; Secretary of Defense Les Aspin, "The Bottom Up Review: Forces for a New Era," Washington, OSD, September 1, 1993, pp. 9, 11-12; Chairman of the Joint Chiefs of Staff, "Report on the Roles, Missions, and Functions of the Armed Forces of the United States," Washington, Office of the CJCS, February, 1993, pp. II-6 to II-7 and II-10 to II-11; General Ronald R. Fogleman, Commander in Chief, US Transportation Command, "Defense Transportation in a Changing World," Statement to the Senate Armed Services Committee, April 22, 1993, pp. 9-10.

[157] GAO, "Desert Shield/Desert Storm: US Transportation Command's Support of Operation," Washington, GAO/NSIAD-92-54, January, 1992, pp. 5-10.

[158] See Captain Vincent C. Thomas, "The Sea Services Role in Desert Shield/Storm," Seapower, September, 1991, pp. 27-33; and GAO, Operation Desert Shield: Problems in Deploying by Rail Need Attention, Washington, GAO/NSIAD-93-30, November, 1992..

[159] US Navy, "From The Sea, Preparing the Naval Service for the 21st Century" Washington, Department of the Navy, September, 1992, pp. 9-10.

[160] See US Navy and USMC, "...From the Sea: Preparing the Naval Service for the 21st Century," Washington, September, 1992; Rear Admiral Philip Quast, USN, Surface Warfare Division, and Major General Harry Jenkins, Jr., USMC, Expeditionary Forces Division, "Joint Littoral Warfare Assessment, New Directions and New Force Structures...From the Sea With Vision," Washington, US Navy, June, 1993; and Secretary of Defense Les Aspin, "The Bottom Up Review: Forces for a New Era," Washington, OSD, September 1, 1993.