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NAVAL WAR COLLEGE
Newport, RI



Sea Control: What does it mean now and what *should* it mean in the future?

By
Cameron Caroom
Major, United States Air Force

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

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

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4 May 2009

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ABSTRACT

This paper argues that current definition of sea control / maritime superiority should be changed to reflect that freedom of movement of one's own aircraft is not necessary in order to affect operations at sea. Instead, what is required is either freedom from attack by air or ability to defend successfully against such an attack. This perspective closely parallels U.S. Army land warfare doctrine and is explored comparatively. A brief review of air power definitions and theory introduces review of two land battle case studies and two sea battle case studies. After establishing a common capability to fight without air superiority, existing and emergent technologies are applied to the operational and tactical need to be able to operate in this manner. Finally, doctrinal changes are recommended to demonstrate that eliminating the air superiority prerequisite from the sea control definition will afford greater Joint Force Commander flexibility for modern operations at sea.

INTRODUCTION

Whosoever can hold the sea has command of everything.

— Themistocles (524 - 460 B.C.)

According to Naval Doctrine Publication 1 (NDP-1), "...the success of an organized military force is associated directly with the validity of its doctrine. Doctrine is the starting point from which we develop solutions and options to address the specific war fighting demands and challenges we face in conducting operations other than war. Doctrine is conceptual — a shared way of thinking that is not directive."¹

At the very heart of most sea service doctrines, including the U.S. Navy's, is the notion of holding the sea as discussed by Themistocles. Holding the sea is commonly described in naval doctrine and theory by the term "sea control." Surprisingly, neither the current version of NDP-1 nor Joint Publication 1-02 (JP 1-02), *Department of Defense Dictionary of Military and Associated Terms*, defines the term "sea control." One must visit the 1978 *Naval Warfare Publication 1 (Revision A): Strategic Concepts of the U.S. Navy* to find sea control defined as, "...the fundamental function of the U.S. Navy and connotes control of designated sea areas and the associated air space and underwater volume. It does not imply simultaneous control of all the earth's ocean area, but is a selective function exercised only when and where needed."² While NDP-1 does not define sea control, it does retain most of the basic implications of the 1978 definition when it states, "[c]ontrol of the sea is fundamental to accomplishing our naval roles. It supports directly our ability to project power ashore by encompassing control of the entire maritime area: subsurface, surface, and airspace, in both the open oceans and the littoral regions of the world."³

However, the "current" NDP-1 published in 1994 is neither particularly current, nor does it adequately reflect the technological advances between 1994 and the present. Just as

the invention of the submarine and the airplane introduced the concept of three-dimensional control into Themistocles's concept of holding the sea, numerous technological advances in the past fifteen years have again muddied what it truly means to "hold the sea" in modern context. Specifically, technological advances in surface-to-air missiles, coupled with the reliance of U.S. Navy forces on space-based capabilities, present several doctrinal alternatives. The first would be to expand the current definition of sea control (also called "maritime superiority" in Joint doctrine) to include control of the subsurface, surface, air, space, and cyberspace as hinted in the U.S. 21st Century Maritime Strategy.⁴ However, due to the massive infrastructure and defense expenditure that would be required to enable U.S. naval forces an organic offensive and defensive counter-space capability, this option will not be explored.

This paper argues that a second, more prudent alternative is to amend the definition of sea control / maritime superiority to reflect that one does not necessarily require freedom of movement of one's own aircraft in order to affect maritime operations. Instead, what is required is either freedom from attack by air or ability to defend successfully against such an attack. This perspective closely parallels U.S. Army land warfare doctrine and will be explored comparatively. A brief review of air power definitions and theory will set the stage for a review of two land battle case studies and two sea battle case studies. After establishing a common capability to successfully fight without air superiority, existing and emergent technologies are applied to the operational and tactical need to be able to operate in this manner. Finally, this paper recommends doctrinal changes to demonstrate that eliminating the air superiority prerequisite from the sea control definition will afford greater JFC flexibility for modern operations at sea.

CLARIFYING ROLES/MISSIONS/FUNCTIONS

As stated in the Introduction, although NDP-1 does not define sea control, it does retain most of the basic implications of the 1978 definition when it states, “[c]ontrol of the sea is fundamental to accomplishing our naval roles. It supports directly our ability to project power ashore by encompassing control of the entire maritime area: subsurface, surface, and airspace, in both the open oceans and the littoral regions of the world.”⁵ Despite retaining the implication of control of the subsurface, surface, and air, this statement begs the question, what are these naval roles?

Joint Publication 0-2, *Unified Action Armed Services*, is one of two capstone publications addressing U.S. Joint Operations, and summarizes the roles, missions, and functions of the U.S. Armed Services. As this publication highlights, “...the terms ‘roles, missions, and functions’ often are used interchangeably, but the distinctions between them are important.”⁶ Accordingly, JP 0-2 defines roles as “the broad and enduring **purposes** for which the Services and the United States Special Operations Command (USSOCOM) were established in law.”⁷ From this definition flows the role of the U.S. Navy to organize, train, and equip forces for prompt and sustained combat incident to operations at sea.⁸ JP 0-2 similarly defines functions as “specific **responsibilities** assigned by the NCA [National Command Authority] to enable the Services to fulfill their legally established roles.”⁹ Based on the JP 0-2 definitions of roles and functions, the previous NDP-1 reference¹⁰ lacks a critical word that was present in the 1978 NWP-1: “function.” This NDP-1 omission thus suggests that sea control¹¹ is a state of being rather than a primary function¹² of the Navy. However, if one assumes that this omission is simply one of those inadvertent, interchangeable uses of the words role and function referred to by JP 0-2, then Sea Control

can properly be viewed as a function of the Navy, and accordingly governed by DoD Directive 5100.1.¹³

Department of Defense Directive 5100.1, *Functions of the Department of Defense and Its Major Components*, specifies that Navy's primary functions are:

to seek out and destroy enemy naval forces and to suppress enemy sea commerce, to gain and maintain general naval supremacy, to control vital sea areas and to protect vital sea lines of communication, to establish and maintain local superiority (including air) in an area of naval operations, to seize and defend advanced naval bases, and to conduct such land, air, and space operations as may be essential to the prosecution of a naval campaign.¹⁴

This directive identifies a doctrinal concern with the current NDP-1. First, what does naval supremacy mean? While not defining naval supremacy, JP 1-02 does define maritime supremacy as, “[t]hat degree of maritime superiority wherein the opposing force is incapable of effective interference.”¹⁵ Based on the JP 1-02 definitions of sea control operations¹⁶ and maritime superiority,¹⁷ we can roughly equate maritime superiority with sea control (as a condition or state of being). More importantly, we finally have a doctrinal foundation to support the NDP-1 assertion that air superiority is required in order to conduct successful maritime operations.

AIR POWER THEORY

As Dr. Richard P. Hallion points out in his thesis, *Control of the Air: The Enduring Requirement*, “...throughout the military history of the twentieth century, the role of aerospace forces has become more predominant.”¹⁸ This assertion will be held as valid for U.S. naval forces, particularly when considering the relative increase in capabilities residing within the carrier aviation forces as compared to the remaining surface vessels. Hallion goes on to state that, “*broadly speaking, control of the air enables a nation to prosecute the fullest range of offensive operations by all its forces against a foe, while, at the same time,*

insulating those forces defensively from meaningful enemy counterattacks.”¹⁹ Again, this assertion will be held as generally valid. However, Hallion’s use of another ambiguous term, air control, particularly when coupled with qualifiers such as “fullest” and “all its forces,” requires further investigation.

First, concerning a definition of air control, Hallion refines this broad term by defining succinctly the air warfare spectrum. Hallion’s spectrum proposes five conditions requiring an increasing magnitude of control: *air paralysis*²⁰, *air inferiority*²¹, *air parity*²², *air superiority*²³, and *air supremacy*.²⁴ Using these definitions, Hallion goes on to suggest that, “if fighting under near ‘parity’ conditions, the battle for control of the air takes on even more critical importance: a nation fighting an equivalent, or near-equivalent, force finds that in the absence of clear control of the air, all of its other military operations are constrained.”²⁵ This assertion also appears to be validated by the requirement to control the air as contained within the current definition of sea control. However, an important conceptual point of departure arises from a close examination of Hallion’s definitions.

Although Hallion’s definitional premises are valid, there is one significant difference between these definitions and those contained in U.S. joint doctrine (where the same terms are defined). Specifically, Hallion’s definitions state that any restrictions or threats imposed on one’s own air forces must result from enemy air force actions. As it pertains to the definition of air superiority, joint doctrine does not make such a distinction; any interference (regardless of source) with own forces as they pertain to the air battle are relevant.²⁶ Interestingly, when defining air supremacy, joint doctrine, like Hallion, requires that the source of interference originate from the opposing air force.²⁷ Hallion later hints at (but fails

to include in his definitions) the possibility of this interference originating from sources other than the enemy's air force when he states:

Finally, the battle for control of the air is commonly thought of as involving defeating the air-to-air threat: the enemy fighter. But, particularly in recent years, defeating the surface-to-air threat--especially in the surface-to-air (SAM) missile age--has taken on its own grave importance. And the continuous upgrading and internetting of both air and surface air control forces--fighters, SAMs, antiaircraft artillery (AAA), radars, and command and control elements--makes this a profound challenge, and one that itself forces a serious examination into the nature of future forces and how they are employed.²⁸

For the purposes of this paper, any hindrance to own air forces, whether from enemy air, naval, or land forces, will be considered equally and incorporated into Hallion's working definitions on a conceptual basis. Utilizing the slight modification to Hallion's conceptual spectrum of air warfare, a new question arises: is it possible to accomplish successful major military operations if operating under conditions of air parity or worse?

LAND WARFARE EXAMPLES

While history offers numerous examples to highlight the dramatic influence of air superiority or supremacy on land warfare, there are also numerous examples where a land force has accomplished its goals, or positioned itself to accomplish these goals, without an overwhelming advantage from the air. For simplicity purposes, one "conventional" operation and one "unconventional" operation are examined below.

On October 6, 1973, Egypt and Syria initiated the Yom Kippur or October War with "one of the best offensive surprises in history."²⁹ In addition to this surprise, one thing differentiated this war from the previous Arab-Israeli wars of 1948, 1956, and 1967 -- an effective Egyptian air defense system. With Soviet advisory help, Egypt established a "missile wall" comprising more than 150 SA-2, SA-3, and SA-6 batteries, thousands of SA-7

shoulder fired missiles, and many ZSU 23-4 anti-aircraft artillery pieces. The sole purpose of this system was to “counter Israeli air superiority” and thereby enable the Egyptian forces to “operate without the devastating losses incurred in every other campaign.”³⁰ The initial effectiveness of the “missile wall” was impressive. During the Israeli Air Force’s (IAF) first 200 sorties, “the Egyptians claimed 27 downed aircraft...aerial losses that would constitute a significant portion of Israeli strength and worse, a tremendous share of their best and most qualified pilots. Almost every loss was from SAMs or antiaircraft fire.”³¹ Operating from behind this “missile wall,” the Egyptians crossed the Suez Canal with losses totaling only 200 people versus the expected 25,000, primarily due to preventing Israel from executing its doctrinal tactics wherein “IDF tanks would lash out in mobile ground attacks, supported, as always, by the IAF.”³² Following the Egyptian crossing of the Suez, both sides expected a major attempt by the Egyptians to reach the Mitla and Gidi passes. However, doing so meant “moving out from under the Egyptian SAM shield, the very event that the Egyptian Chief of Staff, Major General Shazli, was fighting desperately to avoid.”³³ Due to political pressure from Egyptian President Anwar Sadat, Shazli ultimately moved out from under his “SAM shield”, and was defeated militarily. Despite their defeat, however, Egypt did achieve many political goals. As Boyne argues, “Sadat had gone to war to establish the credibility of Arab arms by smashing the Israeli reputation for invincibility...To achieve this he did two bits of masterful planning. The first was the recognition that he could offset superior Israeli airpower and armor by relying on a superabundance of Soviet supplied missiles.”³⁴ Recall that air superiority, as defined by JP 1-02, requires actions by ones own air force to ensure the ability to conduct operations by ones own land, sea, and air forces without prohibitive interference from the air. By relying on missiles rather than its own air force to offset

Israel's airpower, Egypt effectively sacrificed air superiority (since their own air force did not enjoy the ability to conduct operations), yet retained the benefit on the land battle of preventing prohibitive interference from the air. Regardless of whether the war was ultimately a political success, it undisputedly highlighted the capacity to conduct conventional operations without air superiority.

The 1979 Soviet invasion of Afghanistan provides another example of a land force successfully conducting operations without air superiority. Using Hallion's air warfare spectrum, it can be argued that the Afghan Mujahidin had nothing more than air inferiority, bordering on air paralysis. In his paper, "The Air War in Afghanistan," Major Keith Stalder evaluates the opposing forces. His enumeration of the Soviets:

Roughly 140,000 Soviet troops in country and an additional 30,000 on the Soviet side of the border, against 85,000 to 100,000 freedom fighters. Soviet forces are composed of seven motorized rifle divisions and five air assault brigades (about 2,000 men each), 240 gunships, 400 other helicopters, 30-45 MiG-23s, 75-90 MiG-21s and a variety of transport aircraft. Tanks have been estimated at 1,850 and armored personnel carriers at 2,700. Tu-16 BADGERS flying from bases in the Soviet Union routinely support ground operations against the mujahidin.³⁵

His corresponding evaluation of the Afghans:

The principle sources of the limited arms the rebels possess are captured Soviet weapons, black marketeering, and Afghan Army defectors. This meager supply consists of SA-7s, RPGs, 82mm mortars, AK-74s, Enfield rifles, and 12.7mm machine guns. The rebels have made use of an inordinately high number of dud 250 kg Soviet bombs, recovered following air raids. These make crude mines and booby traps. 57mm rocket pods recovered from the wreckage of helicopters have been used to good effect as well.³⁶

As the Mujahidin defense of Afghanistan was conducted over a nine-year period, no specific battles will be examined. Further, many of the reasons for the eventual Mujahidin victory are attributable to reasons beyond the scope of this paper. Nonetheless, the effectiveness of Afghan rudimentary air defense assets (ADA) cannot be overlooked.

According to Colonel-General G.F. Krivosheev, Soviet losses in the air battle over the course of the war included 118 fixed-wing aircraft and 333 helicopters.³⁷ In addition to actual hardware losses, the Mujahidin ADA also limited the tactical effectiveness of Russian air assets. As Major Stalder points out, not only did the Mujahidin ADA force Soviet fixed wing aircraft into higher altitude attacks, it also created an environment where “assault planes’ pilots were given an impossible task – to perform three operations at the same time: seek the target, avoid anti-aircraft fire, and not lose sight of the front line. Under these conditions, pilots frequently made strikes against their own troops.”³⁸ Thus over the course of the nine year Soviet presence in Afghanistan, the Mujahidin were able to conduct successful sustained operations without any air forces at all.

SEA WARFARE EXAMPLES

Just as there are examples of land warfare in which operations were conducted without air superiority, similar examples exist where sea warfare was similarly conducted without air superiority. The first example is the Battle of Empress Augusta Bay, Bougainville, in World War II. In addition to being a naval battle, this event was of critical importance to support the 14,000 U.S. Marines ashore at Cape Torokina to ensure not only their survival, but also to prevent the Japanese from landing 40,000 troops dispatched to ensure Bouganville did not fall to the Americans. During the period 31 Oct 1943 to 2 Nov 1943, Rear Admiral A.S. “Tip” Merrill’s Task Force 39 engaged Vice Admiral Omori Sentaro’s Torokina Interception Force. Task Force 39 comprised four light cruisers and eight destroyers, and had limited air support in the form of twelve sea-based patrol aircraft. The Japanese Torokina Interception Force consisted of two heavy cruisers, two light cruisers, and

six destroyers, and was directly supported by the 250+ Japanese aircraft from Rabaul.³⁹

Based on order of battle alone, it is clear that Merrill did not have air superiority.

In the battle, TF-39 successfully engaged the Torokina Interception Force, sinking one light cruiser, one destroyer, and one transport, while damaging four other ships. Of particular significance to air superiority is the event at approximately 0800 local on 2 Nov when TF-39 was attacked by approximately 100 Japanese aircraft from Rabaul. During the course of the attack, not only did TF-39 ships shoot down 17 aircraft with anti-aircraft fire, they also managed to avoid any significant damage from the attacks, with only one ship sustaining superficial hits from two bombs⁴⁰.

The second sea warfare example also comes from World War II in the Soviet Campaign to defend the Crimean Peninsula. During this campaign, the Soviets perceived that “the Black Sea Fleet could guarantee sea mastery by actively mining and through the actions of submarines to prevent: the entrance of enemy ships into the Black Sea through Strait, the supply of forces and military equipment into the ports of Romania, Bulgaria, and Turkey by sea, and the embarkation of landing forces.”⁴¹ To counter this effort, the Germans under “...the initial BARBAROSSA plan envisioned that the Black Sea Fleet’s superiority would be offset, and possibly even eliminated, by a combination of air-deployed sea mines, light naval forces, and the Luftwaffe. By late 1941, however, this initial assumption proved faulty because the Soviets maintained sea control.”⁴² All of the naval actions in opposition to the initial BARBAROSSA plan were ultimately successful despite the Soviet lack of air superiority.

The lack of air superiority was attributable to “deficiencies in fighter-bomber aircraft and anti-aircraft guns...the Black Sea Fleet Air Force reported a strength of approximately 630

aircraft in late 1941, only about 30 of them were modern fighter or attack aircraft - supplemented by another 40 fighters considered to be obsolete.”⁴³

When major combat operations resumed in spring 1942, the Soviet situation from an air perspective worsened. On May 8, as part of Operation TRAPPENJAGD, “good flying weather allowed Fliegerkorps VIII to achieve complete air superiority.”⁴⁴ To support their victories on land, the Germans introduced “a new German naval command in the Black Sea [which was] supported by the Luftwaffe. [These naval forces were tasked] to assume the duties of coastal and harbor defense in occupied territories, and even carrying out minor offensive operations against the Black Sea Fleet.”⁴⁵

However, despite success on the ground and in the air, the Germans could not prevent the Black Sea Fleet from maintaining a measure of sea control. “From early June to July 1942, Black Sea Fleet submarines completed 78 trips to Sevastopol, delivering approximately 4,000 tons of ammunition and supplies as well as evacuating more than 1,300 wounded troops and city residents.”⁴⁶ Although Sevastopol’s failed defense was a localized tactical failure, the Black Sea Fleet ability to continue operations with, at best, air inferiority (in Hallion’s terms) proved critical to prolonging the fight in the Crimea. Operations TRAPPENJAGD and STORFANG were “Germany’s last major victory on the Eastern front, but came at the heavy cost of over 27,000 Axis casualties and rendered the Eleventh Army combat ineffective.”⁴⁷ Thus, the Black Sea Fleet arguably provided an operational level victory by its ability to maintain sea control in the absence of air superiority

LAND WARFARE MENTALITY APPLIED TO SEA WARFARE

Critics of the proposed definition change are likely to argue that sea warfare is different due to the lack of terrain and thus increased vulnerability to attack from the air. At

a very fundamental level, sea warfare is clearly different from land warfare due to the environment. However, despite such difference, the basic objectives of the two forms of warfare are still defined almost identically.^{48,49} Despite all definitional similarities between land and sea warfare, there is one fundamental difference at the doctrinal level: the need for air superiority. Unlike NDP-1, which mandates air superiority as a precondition to naval force employment,⁵⁰ U.S. Army Field Manual (FM) 1-0 contains no references to air superiority and FM 3-0 contains only two references. This paper freely concedes that air superiority enables a fuller spectrum of operations at sea just as it does on land. However, in cases where air superiority is either not required or not readily achievable, U.S. maritime forces still must be able to perform effectively the primary functions prescribed in DoD Directive 5100.1.

THE TECHNOLOGY FACTOR: MODERN SURFACE-TO-AIR MISSILES (SAMS)

Largely as a function of U.S. air power predominance in modern warfare, and the cost associated with manning, training, and equipping a modern air force, many countries invest heavily in integrated air defense systems (IADS) to deny hostile air superiority. Table 1 below highlights the type, range, and initial operating capability (IOC) status of the most modern and emergent SAMs, which are a critical IADS component. Further complicating the challenge of obtaining air superiority against robust IADS is the fact that most SAM systems are mobile on land and sea.

<u>SAM Numeric Designator</u>	<u>Operational Range (NM)</u>	<u>IOC Status</u>
SA-10 (S-300) ⁵¹	54	IOC
SA-20 (S-300 PMU-2) ^{*52} SA-N-20 = Naval Variant	120	IOC
SA-21 (S-400) ⁵³	150	IOC
HQ-9 ^{*54} *HHQ-9 = Naval Variant	120	IOC
FT-2000 ⁵⁵	54	Developmental* *Passive SAM
S-500 ⁵⁶	UNK* *Reported 2100NM range vs. ballistic missile targets	Developmental

Table 1 Advanced SAM Ranges (Data derived from Jane's, individually sourced above)

Perhaps the most distressing fact of all is that the two countries most active in acquiring advanced SAM technology are also the two countries most likely to try and impose sea denial on the U.S., namely Iran and China.

IRAN

In the December 12, 2008, edition of *Aviation Week and Space Technology*, a U.S. Government official stated, “The Iranians are on contract for the SA-20. We've got a huge set of challenges in the future that we've never had [before]. We've been lulled into a false sense of security because our operations over the last 20 years involved complete air dominance and we've been free to operate in all domains.”⁵⁷ This same official goes on to state, “the proliferation of so-called double-digit surface-to-air missile systems - such as the Almaz Antey SA-20 (S-300PMU1/S-300PMU2) - poses an increasing threat to non-stealthy aircraft, and will force changes in tactics and operational planning. These modern weapon

systems are going to deny us strategic and operational options that in the past we haven't had to worry about."⁵⁸

As Bulghum and Barrie highlight, these advanced long-range missile systems will undoubtedly be deployed with a contingent of advanced point defense systems. These advanced systems, such as the SA-15 or SA-22, will augment the organic capability of the SA-20 against targets such as precision guided munitions or cruise missiles⁵⁹. Needless to say, any effort to gain air superiority in proximity of a system (or systems) such as the SA-20 will require a dedicated effort, and such an effort is not likely to be swift.

The good news in the case of Iran is that air superiority is simply not required for naval operations in the vicinity of the Strait of Hormuz. *Globalsecurity.org*, along with other creditable analysts, highlights the combat ineffectiveness of the Iranian Imperial Air Force (IIAF) as far back as 1987:

By 1987, the Air Force faced a new problem, one of an acute shortage of spare parts and replacement equipment. Perhaps 35 of the 190 Phantoms were serviceable in 1986. One F-4 had been shot down by Saudi F-15s, and two pilots had defected to Iraq with their F-4s in 1984. The number of F-5s dwindled from 166 to perhaps 45, and the F-14 Tomcats from 77 to perhaps 10. The latter were hardest hit because maintenance posed special difficulties after the United States embargo on military sales.⁶⁰

Figure 1 below depicts a notional placement of three SA-20 missile systems. As can be seen, the SA-20 easily has the capability to deny air superiority in and around the Strait of Hormuz. However, given the historical IIAF combat ineffectiveness, one must ask the question: does this situation require air superiority to accomplish the DoD 5100.1 functions previously discussed? Another way to ask the question is, will delaying naval operations within the Strait of Hormuz be worth the time required to gain air superiority? As with many complex decisions, this one will come down to managing risk. In the case of an SA-20 threat

in the Strait of Hormuz, arguably a most vital choke point and sea line of communication, the answer is simply “no.” The increased risk to forces if required to destroy SA-20 batteries, combined with risk to overall mission by delaying critical naval tasks such as mine warfare (MW), submarine warfare (SW), and surface warfare (SuW), in order to gain air superiority, is simply not acceptable.



Figure 1. Notional Advanced SAM Placement in Strait of Hormuz⁶¹

CHINA

The prospect of sea denial in the vicinity of the Taiwan Strait poses a much more challenging problem to the United States. Figure 2 depicts a notional deployment of 1 SA-20/HQ-9, 1 SA-21, and 2 SA-N-20/HHQ-9. Various unclassified, unconfirmed sources also report an extended range of the SA-21 beyond the white line depicted (150 NM according to Jane's) to 215 NM⁶². This possible extended capability is depicted in Figure 2 by the dotted white ring to the east of Taiwan. Even without the extended SA-21 range, the air defense picture alone is extremely foreboding. Distinctly different from the IIAF, the Peoples Liberation Army Air Force (PLAAF) and People's Liberation Army Naval Air Force

(PLANAF) possess a very credible air threat in quantity and capability. Given this daunting combined arms capability, the Taiwan Strait operating area presents a challenge where air superiority will be most difficult to attain. However, just as with the Strait of Hormuz, the requirement to conduct maritime operations still clearly exists.

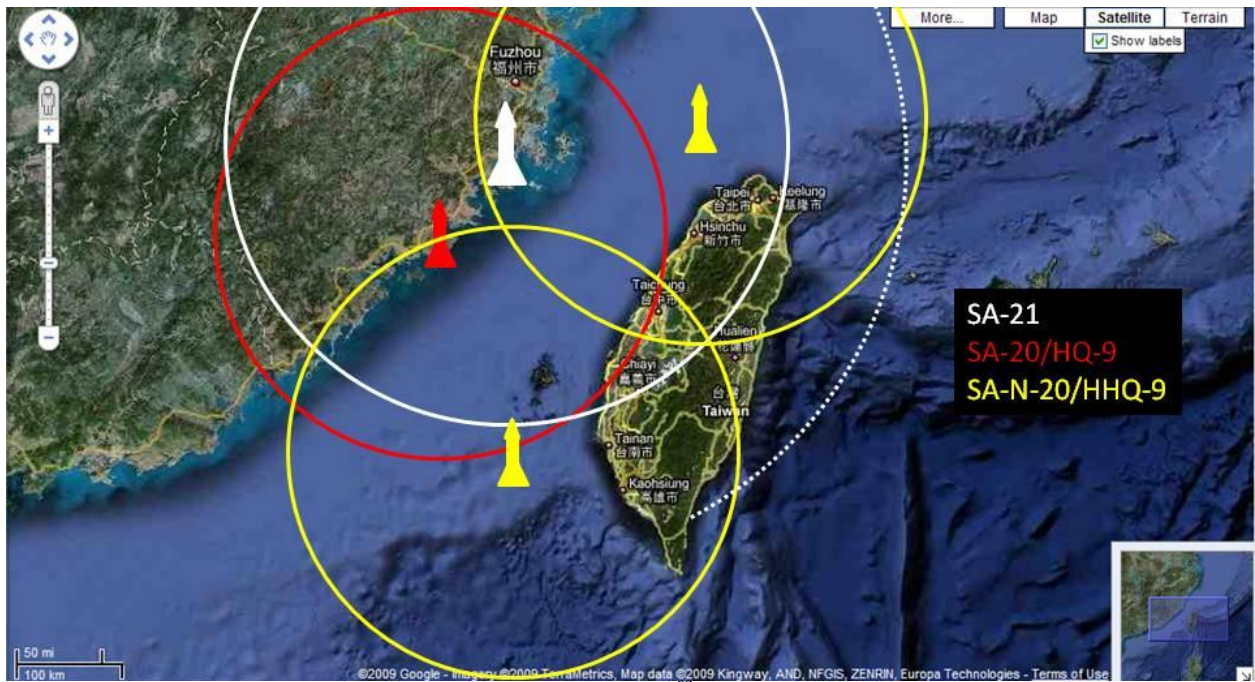


Figure 2. Notional Advanced SAM placement in Taiwan Strait⁶³

DENYING ENEMY AIR SUPERIORITY - HALF THE SOLUTION

One of the first solutions proposed to solve problems created by mandating air superiority within sea control is self-defense. As it pertains to the air portion of the definition of sea control, this effectively asks, can naval forces prevent an opposing force from exercising air superiority by imposing a level of “prohibitive interference”⁶⁴ through a means other than naval air forces?

The answer is “yes.” Air Warfare (AW) is a capstone strength of U.S. naval forces, enabled primarily by SM-2 and SM-3 missiles. With ranges exceeding 100 NM, these missiles possess the kinetic ability to limit or deny air space to opposing forces. The cruiser-

destroyer AEGIS weapons system, with its SPY-1 radar, has significant capability to track and engage multiple targets, providing the necessary target acquisition for the missiles. Critical to extending the range, redundancy, and effectiveness of the naval SAM umbrella is the common operational picture (COP) at the heart of the Navy's Cooperative Engagement Capability (CEC). Vastly simplified, the CEC fuses sensor data from all available platforms to obtain high quality targeting solutions very quickly, even in an electronic attack environment. The shared data increases the number of SAM shooters by "pushing" targeting information to any platform capable of engaging targets in the air. The resulting effect is the world's most effective SAM umbrella, denying enemy air superiority within it.⁶⁵

SURVIVABILITY - THE OTHER HALF SOLUTION

Despite being unable to achieve local air superiority, enemy air forces can attack surface ship targets from beyond SM-2/3 range due to cruise missile technology improvements. If unable to defend against such attacks, the surface vessels remain at risk, and the SM-2/3 protective umbrella is ultimately insufficient. Fortunately, the capability to defend against extended range threats is also resident within the CEC. Its robustly shared air picture includes not only enemy aircraft, but also the cruise missiles they might employ. Armed with this shared picture, the U.S. Navy has a very good capability to engage (and thus defend against) these cruise missiles. In his Naval Post Graduate School thesis, LT. Richard O. Johns analyzes this capability in detail, revealing an overall system effectiveness of 93.6 percent to 94.5 percent against Exocet-type cruise missiles⁶⁶. Combined with the ability to deny enemy air superiority, the promise of CEC self-defense offers the JFC flexibility and combat power not available under current doctrinal definitions.

RECOMMENDATIONS

Doctrinal modifications should be made in order to achieve several key tasks. First, sea control must be clearly defined in not only U.S. Naval and Navy doctrine, but also in joint doctrine. Sea control should be defined by deleting two words (air space) from the 1978 NWP-1 definition to read, “Sea control is the fundamental function of the U.S. Navy and connotes control of designated sea areas and the associated underwater volume. It does not imply simultaneous control of all the earth’s ocean area, but is a selective function exercised only when and where needed.”⁶⁷ This new definition not only eliminates the need for air superiority, but also clearly prescribes sea control as a function rather than a condition or state of being.

Second, the definition for the condition or state of being -- maritime superiority -- must similarly change. Again, this change should be made simply by deleting two words (and air). “Maritime Superiority” would then be defined as, “that degree of dominance of one force over another that permits the conduct of maritime operations by the former and its related land and maritime forces at a given time and place without prohibitive interference by the opposing force.”⁶⁸

Similarly, the U.S. Naval Services must decide upon the most correct terminology to describe the actions associated with the Themistoclean concept of “holding the sea,” sea control or maritime superiority. While such delineation may seem trivial to the casual observer, the importance -- particularly in the joint environment -- of clearly differentiating between a function (sea control) and a condition (maritime superiority) cannot be underestimated.

RESULTING EMERGENT COMBAT CAPABILITY

These recommended changes in no way diminish air power contributions to sea control. Rather, they serve to highlight some key areas where the U.S. military can become more capable. The first deals with the warfare task of anti-submarine warfare (ASW). The *Cooperative Strategy for 21st Century Sea Power* accurately captures the emerging threat when it states, “there are many challenges to our ability to exercise sea control, perhaps none as significant as the growing number of nations operating submarines, both advanced diesel-electric and nuclear propelled.”⁶⁹ These advanced diesel-electric submarines present the most challenging proposition due to their numbers and propensity to operate in or near the littorals. Eliminating the requirement for air superiority in order to conduct ASW creates greater challenge for naval surface forces due to lack of maritime patrol air coverage by P-3 aircraft. Surface force technical capability to operate in this fashion appears to be progressing via the littoral combat ship (LCS) with the anti-submarine warfare (ASW) module.⁷⁰ Armed with the capability to conduct ASW, eliminating the need for air superiority would provide expanded opportunities in littoral areas that would have otherwise been inaccessible.

The second warfare task of critical concern is surface warfare (SuW). In SuW, U.S. naval forces rely on two primary vehicles of attack: aircraft and submarines. As a result, U.S. Navy surface capability to engage enemy surface combatants directly is best described as limited. Modern naval peer competitors -- Russia, China, and India – do not have the same limitation due to over-the-horizon (OTH) targeting capability with advanced cruise missiles such as the Russian SS-N-22 Sunburn, Chinese YJ-62, and the PJ-10 BrahMos. Directly attacking the launch platforms is arguably more effective than relying primarily on shooting down the missiles. Thus, eliminating the need for (and reliance upon) air

superiority has the potential benefit of further mitigating the threat of these cruise missiles through the development of a similar if not increased capability by U.S. naval forces. Such capability could also improve surface ship self-defense against swarm type attacks in the littoral regions.

The final warfare task of critical concern is mine warfare (MIW). Technologically advanced SAMs provide an enemy with robust capability to deny or delay U.S. access to a particular geographic location if doctrine requires air superiority as a first condition. For a time-intensive warfare task like MIW, this could be a show-stopper. The mere ability to begin prosecuting assigned MIW tasks without air superiority, but with the ability to defend MW assets from air attack, reaps significant reward for the JFC.

CONCLUDING REMARKS

According to the *U.S. Maritime Strategy for the 21st Century*, "...the speed, flexibility, agility and scalability of maritime forces provide joint or combined force commanders a range of options for responding to crises."⁷¹ It goes on to state that, "In times of war, our ability to impose local sea control, overcome challenges to access, force entry, and project and sustain power ashore, makes our maritime forces an indispensable element of the joint or combined force."⁷² These tasks are directly reflected in three major functions required of the U.S. Navy in DoDI 5100.1, "control vital sea areas and to protect vital sea lines of communication, to establish and maintain local superiority in an area of naval operations, and to seize and defend advanced naval bases." To accomplish these tasks requires sustained operations in littoral areas. As earlier noted, if air superiority is a precondition to operate in these regions, access can be denied or delayed significantly by enemy SAMs. The enemy ability to deny access using SAMs opposes the *U.S. Maritime*

Strategy for the 21st Century, which further states, “The expeditionary character and versatility of maritime forces provide the U.S. the asymmetric advantage of enlarging or contracting its military footprint in areas where access is denied or limited.”⁷³ Thus, in order to enable U.S. naval forces to operate in accordance with the U.S. Maritime Strategy, the definition of sea control must change to enable that very ability.

NOTES

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- ¹ Secretary of the Navy. *Naval Doctrine Publication 1: Naval Warfare*. (Washington, DC: Department of the Navy, 1994) ii.
- ² Chief of Naval Operations. *Naval Warfare Publication 1 (Revision A): Strategic Concepts of the U.S. Navy*. (Washington, DC: Department of the Navy, CNO, 1978) I-3-1.
- ³ United States, United States Navy, *Naval Doctrine Publication 1: Naval Warfare* (USN, 1994), pg. 26.
- ⁴ “The ability to operate freely at sea is one of the most important enablers of joint and interagency operations, and sea control requires capabilities in all aspects of the maritime domain, including space and cyberspace.” United States, *A Cooperative Strategy for 21st Century Seapower* (U.S. Department of Defense, 2007), 13.
- ⁵ United States, United States Navy, *Naval Doctrine Publication 1: Naval Warfare* (USN, 1994), pg. 26.
- ⁶ United States. Department of Defense. Joint Publication 0-2: Unified Action Armed Forces. DoD, 2001, I-6
- ⁷ Ibid.
- ⁸ Title X, U.S. Code.
- ⁹ United States, Department Of Defense, *Joint Publication 0-2: Unified Action Armed Forces (UNAAF)* (United States, 2001), p. I-6.
- ¹⁰ “Control of the sea is fundamental to accomplishing our naval roles.” NDP-1, ii.
- ¹¹ *From the Merriam Webster Dictionary* Control - to exercise restraining or directing influence over; to have power over
- ¹² *From the Merriam Webster Dictionary* function - the action for which a person or thing is specially fitted or used or for which a thing exists
- ¹³ This assumption is validated by the JP 1-02 definition of Sea Control Operations as a task.
- ¹⁴ United States. Department of Defense. Directive 5100.1: Functions of the Department of Defense and Its Major Components, 2003, 18.
- ¹⁵ United States. Department of Defense. Joint Publication 1-02: *Department of Defense Dictionary of Military and Associated Terms*, 2008, 332.
- ¹⁶ The employment of naval forces, supported by land and air forces as appropriate, in order to achieve military objectives in vital sea areas. Such operations include destruction of enemy naval forces, suppression of enemy sea commerce, protection of vital sea lanes, and establishment of local military superiority in areas of naval operations. (JP 1-02, 485).
- ¹⁷ maritime superiority — That degree of dominance of one force over another that permits the conduct of maritime operations by the former and its related land, maritime, and air forces at a given time and place without prohibitive interference by the opposing force. (JP 1-02, 332).
- ¹⁸ Dr. Richard P. Hallion, *Control of the Air: The Enduring Requirement*, diss., Air Force History and Museums Program, 1999 (United States, 1999), pg. 4.
- ¹⁹ Ibid, 5.
- ²⁰ “...a nation unable to undertake offensive military action of any significance because it is controlled by enemy air forces; there is no hope of victory, and the enemy has air supremacy.” Ibid, 6.
- ²¹ “...a nation can undertake limited offensive military action possessing some potential significance, but only by taking the enemy’s air activity into consideration.” Ibid.
- ²² “...both sides are so relatively balanced in forces, capabilities, training, etc., that each can secure, by marshaling the necessary forces at a particular time and point, *localized* air superiority over a portion of a front or theater.” Ibid.
- ²³ “...a war where a nation that can exert its power over a foe with few air losses of its own, and without serious concern about the enemy’s ability to contest for control of the air with its own air forces.” Ibid.
- ²⁴ “...a nation can control a foe with essentially no or absolutely minimal air losses of its own, and without need to concern itself about the enemy’s air intentions.” Ibid.
- ²⁵ Ibid, 4.
- ²⁶ United States, Department Of Defense, *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms* (United States, 2008),p. 28.
- ²⁷ Ibid.
- ²⁸ Hallion, 7.
- ²⁹ Walter J. Boyne, *The Two O’Clock War The 1973 Yom Kippur Conflict and the Airlift That Saved Israel*

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- (New York: Thomas Dunne Books, 2002), pg. xiv.
- ³⁰ Ibid, p. 15
- ³¹ Ibid, p.34-35
- ³² Ibid. p. 35
- ³³ Ibid, p. 92
- ³⁴ Ibid, p. 273
- ³⁵ Keith J. Stalder, "The Air War in Afghanistan" (thesis, Marine Corps Command and Staff College, 1985), <http://www.globalsecurity.org/military/library/report/1985/SKJ.htm> (accessed March 4, 2009).
- ³⁶ Ibid, 17.
- ³⁷ G.F. Krivosheev, *Soviet casualties and combat losses in the twentieth century* (London: Greenhill Books, Stackpole Books, 1997).
- ³⁸ Stalder, p. 20.
- ³⁹ Kent G. Budge, *The Pacific War Online Encyclopedia*, s.v. "Empress Augusta Bay," http://pwencycl.kgbudge.com/E/m/Empress_Augusta_Bay.htm (accessed April 9, 2009).
- ⁴⁰ Elmer B. Potter, Roger Fredland, and Henry H. Adams, *Sea power a naval history* (Annapolis, Md: Naval Institute P, 1981), 314.
- ⁴¹ *Joint Military Operations Department Operational Art Examination Case Study Operations in the Crimea—1941-1942*, THE UNITED STATES NAVAL WAR COLLEGE, p. 17
- ⁴² Ibid, p. 17-18
- ⁴³ Ibid, p. 16-17.
- ⁴⁴ Ibid, p. 41.
- ⁴⁵ Ibid, p. 41.
- ⁴⁶ Ibid, p. 44.
- ⁴⁷ Ibid, p. 46.
- ⁴⁸ "**land control operations** — The employment of ground forces, supported by naval and air forces (as appropriate) to achieve military objectives in vital land areas. Such operations include destruction of opposing ground forces, securing key terrain, protection of vital land lines of communications, and establishment of local military superiority in areas of land operations. See also **sea control operations**." JP 1-02, p. 305.
- ⁴⁹ "**sea control operations** — The employment of naval forces, supported by land and air forces as appropriate, in order to achieve military objectives in vital sea areas. Such operations include destruction of enemy naval forces, suppression of enemy sea commerce, protection of vital sea lanes, and establishment of local military superiority in areas of naval operations. See also **land control operations**." JP 1-02, p. 485
- ⁵⁰ "After achieving maritime and air superiority, naval forces can continue to operate as an integrated part of a larger joint organization or disengage to respond to another need for their presence." NDP-1, p. 28.
- ⁵¹ "S-300/Favorit (SA-10 'Grumble'/SA-20 'Gargoyle')," Jane's Land Based Air Defence, http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jsws/jsws0179.htm@current&keyword=s-300&pageSelected=allJanes&backPath=http://search.janes.com/Search&Prod_Name=JSWS (accessed April 04, 2009).
- ⁵² Ibid.
- ⁵³ "S-400 Triumf," Jane's Land Based Air Defence, http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/yb/jlad/jlad0593.htm@current&pageSelected=allJanes&keyword=s-400&backPath=http://search.janes.com/Search&Prod_Name=JLAD& (accessed April 04, 2009).
- ⁵⁴ "HQ-9/FT-2000," Jane's Land Based Air Defence, http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/yb/jlad/jlad0520.htm@current&pageSelected=allJanes&keyword=HQ-9&backPath=http://search.janes.com/Search&Prod_Name=JLAD& (accessed April 04, 2009).
- ⁵⁵ Ibid.
- ⁵⁶ "S-500," MissileThreat.com,

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- http://www.missilethreat.com/missiledefensesystems/id.54%20/system_detail.asp (accessed April 04, 2009).
- ⁵⁷ David A. Fulghum and Douglas Barrie, "Russia Sells SA-20 to Iran," *Aviation Week and Space Technology*, December 12, 2008.
- ⁵⁸ Ibid.
- ⁵⁹ Ibid.
- ⁶⁰ "Iran Air Force," GlobalSecurity.org - Reliable Security Information, section goes here, <http://www.globalsecurity.org/military/world/iran/airforce.htm> (accessed April 04, 2009).
- ⁶¹ Map is derived from Google.com. SA-20 range rings are added after the fact in arbitrary coastal locations using the max effective ranges from Jane's.
- ⁶² http://www.strategycenter.net/research/pubID.93/pub_detail.asp
- ⁶³ Map is derived from Google.com. All SAM range rings are added after the fact in arbitrary coastal locations using the max effective ranges from Jane's.
- ⁶⁴ "**air superiority** — That degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force." JP 1-02, p. 28.
- ⁶⁵ William D. O'Neil, *The Cooperative Engagement Capability (CEC): Transforming Naval Anti-air Warfare*, working paper (Washington D.C.: Center for Technology and National Security Policy, 2007).
- ⁶⁶ Richard O. Johns, *AAW Effectiveness of the DD-963 Spruance Class Destroyer: An Analytic Approach*, thesis, Naval Postgraduate School, 1996 (Corona: Naval Warfare Assessment Division, 1996), pg. 28.
- ⁶⁷ United States. U.S. Navy. *Naval Warfare Publication 1 (Revision A): Strategic Concepts of the U.S. Navy*. USN, 1978, I-3-1.
- ⁶⁸ United States, Department of Defense, *Joint Publication 3-32: Command and Control for Maritime Joint Operations* (Joint Staff, 2006), pg. x.
- ⁶⁹ United States, *A Cooperative Strategy for 21st Century Seapower* (U.S. Department of Defense, 2007), pg.13.
- ⁷⁰ "US Navy Rolls Out Littoral Combat Ship Anti-Submarine Warfare Mission Package," Guide to Military Equipment and Civil Aviation, section goes here, http://www.deagel.com/news/US-Navy-Rolls-Out-Littoral-Combat-Ship-Anti-Submarine-Warfare-Mission-Package_n000005009.aspx (accessed April 04, 2009).
- ⁷¹ United States, *A Cooperative Strategy for 21st Century Seapower* (U.S. Department of Defense, 2007), pg. 8.
- ⁷² Ibid.
- ⁷³ Ibid.

BIBLIOGRAPHY

- Boslaugh, David L. *When Computers Went to Sea The Digitization of the United States Navy (Perspectives)*. New York: Wiley-IEEE Computer Society Pr, 2003.
- Boyne, Walter J. *The Two O'Clock War The 1973 Yom Kippur Conflict and the Airlift That Saved Israel*. New York: Thomas Dunne Books, 2002.
- Buckwalter, David T. "The 1973 Arab-Israeli War." In *Case Studies in Policy Making and Process*. 9th ed. Edited by Policy Making and Process Faculty. Newport, R.I.: Naval War College, 2005.
- Budge, Kent G. *The Pacific War Online Encyclopedia*.
http://pwencycl.kgbudge.com/E/m/Empress_Augusta_Bay.htm (accessed April 9, 2009).
- DoD Directive 5100.1: Functions of the Department of Defense and Its Major Components (2003).
- Fieldhouse, Richard W. *Superpowers at sea an assessment of the naval arms race*. Oxford: Oxford UP, 1989.
- Fulghum, David A., and Douglas Barrie. "Russia Sells SA-20 to Iran." *Aviation Week and Space Technology*, December 12, 2008.
- Fuquea, D. C. "Night Fighters Without Equal, Task Force 39 at Empress Augusta Bay." Thesis, Navy War College, 2004.
- Hall, Michelle. *The Blue Water Dragon: China's Emerging Aircraft Carrier Force*. Report. U.S. Naval War College, 2008.
- Hallion, Richard P. *Control of the Air: The Enduring Requirement*. Diss., Air Force History and Museums Program, 1999. United States, 1999.
- "HQ-9/FT-2000." Jane's Land Based Air Defence.
http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/yb/jlad/jlad0520.htm@current&pageSelected=allJanes&keyword=HQ-9&backPath=http://search.janes.com/Search&Prod_Name=JLAD& (accessed April 04, 2009).
- Hurley, Matthew M. "The BEKKA Valley Air Battle, June 1982: Lessons Mislearned?" *Air Power Journal* (Winter 1989).
- "Iran Air Force." GlobalSecurity.org - Reliable Security Information.
<http://www.globalsecurity.org/military/world/iran/airforce.htm> (accessed April 04, 2009).

Johns, Richard O. *AAW Effectiveness of the DD-963 Spruance Class Destroyer: An Analytic Approach*. Thesis, Naval Postgraduate School, 1996. Monterey: USN, 1996.

Joint Military Operations Department Operational Art Examination Case Study Operations in the Crimea:1941-1942. THE UNITED STATES NAVAL WAR COLLEGE.

Krivosheev, G.F. *Soviet casualties and combat losses in the twentieth century*. London: Greenhill Books, Stackpole Books, 1997.

Merriam Webster Online Dictionary. <http://www.merriam-webster.com/dictionary/control> (accessed April 4, 2009).

Merriam Webster Online Dictionary. <http://www.merriam-webster.com/dictionary/function> (accessed April 4, 2009).

Norman, Friedman,. *US maritime strategy*. London: Jane's, 1988.

O'Neil, William D. *The Cooperative Engagement Capability (CEC): Transforming Naval Anti-air Warfare*. Working paper. Washington D.C.: Center for Technology and National Security Policy, 2007.

Potter, Elmer B., Roger Fredland, and Henry H. Adams. *Sea power a naval history*. Annapolis, Md: Naval Institute P, 1981.

"S-300/Favorit (SA-10 'Grumble'/SA-20 'Gargoyle')." Jane's Land Based Air Defence. http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jsws/jsws0179.htm@current&keyword=s-300&pageSelected=allJanes&backPath=http://search.janes.com/Search&Prod_Name=JSWS (accessed April 04, 2009).

"S-400 Triumf." Jane's Land Based Air Defence. http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/yb/jlad/jlad0593.htm@current&pageSelected=allJanes&keyword=s-400&backPath=http://search.janes.com/Search&Prod_Name=JLAD& (accessed April 04, 2009).

"S-500." MissileThreat ::. http://www.missilethreat.com/missiledefensesystems/id.54%20/system_detail.asp (accessed April 04, 2009).

Singh, Jasjit. *Air Power in Modern Warfare*. New Delhi: Lancer International, 1988.

Sipe, Charles. *Sea Control: The Role of Land-Based Air Power*. Report. U.S. Naval War

-
- College, 1991.
- Stalder, Keith J. "The Air War in Afghanistan." Thesis, Marine Corps Command and Staff College, 1985. <http://www.globalsecurity.org/military/library/report/1985/SKJ.htm> (accessed March 4, 2009).
- United States. *A Cooperative Strategy for 21st Century Seapower*. U.S. Department of Defense, 2007.
- United States. Air Force. *Air Force Doctrine Document 1*. USAF, 2003.
- United States. Department Of Defense. *Joint Publication 1-02: Department of Defense Dictionary of Military and Associated Terms*. United States, 2008.
- United States. Department of Defense. *Joint Publication 3-0: Joint Operations*. Joint Staff, 2008.
- United States. Department of Defense. *Joint Publication 3-32: Command and Control for Maritime Joint Operations*. Joint Staff, 2006.
- United States. Department Of Defense. *Joint Publication 0-2: Unified Action Armed Forces (UNAAF)*. United States, 2001.
- United States. United States Navy. *Navy Doctrine Publication 1: Naval Warfare*. USN, 1994.
- "US Navy Rolls Out Littoral Combat Ship Anti-Submarine Warfare Mission Package." Guide to Military Equipment and Civil Aviation. http://www.deagel.com/news/US-Navy-Rolls-Out-Littoral-Combat-Ship-Anti-Submarine-Warfare-Mission-Package_n000005009.aspx (accessed April 04, 2009).
- Vego, Milan N. *Joint Operational Warfare: Theory and Practice*. Newport: NWC, 2007.
- Vego, Milan N. *Naval Strategy and Operations in Narrow Seas (Cass Series--Naval Policy and History)*. New York: Routledge, 2003.
- Vego, Milan. *Operational Warfare at Sea: Theory and Practice (Cass Series: Naval Policy and History)*. New York: Routledge, 2008.