REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
10-02-2015	Research	Oct 2014 - Feb 2015

4. TITLE AND SUBTITLE
Past as Prologue: Leveraging Lessons-learned from the Air to Facilitate Amphibious Forcible Entry in an A2AD Threat Environment

5a. CONTRACT NUMBER
N/A

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)
Major John J. Roma, USMC

5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
USMC School of Advanced Warfighting
Marine Corps University
3070 Moreell Avenue
Quantico, VA 22134-5068

8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSOR/MONITOR'S ACRONYM(S)
N/A

11. SPONSORING/MONITORING AGENCY REPORT NUMBER
N/A

12. DISTRIBUTION AVAILABILITY STATEMENT
Unlimited

13. SUPPLEMENTARY NOTES
N/A

14. ABSTRACT
The United States Navy and Marine Corps must capitalize on past lessons learned in penetrating hostile Integrated Air Defense Systems and leverage existing naval decoy technology and obscurants as a means to facilitate forcible entry operations in an A2/AD threat environment.

15. SUBJECT TERMS
Navy, Marine Corps, A2/AD, anti-access, area-denial, naval decoy, obscurants, forcible entry, amphibious operations

16. SECURITY CLASSIFICATION OF: a. REPORT	b. ABSTRACT	c. THIS PAGE	17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
Unclassified	Unclassified	Unclassified	UU	21	Marine Corps University / School of Advanced Warfighting
					19b. TELEPONE NUMBER *(Include area code)* (703) 432-5318 (Admin Office)

United States Marine Corps
School of Advanced Warfighting
Marine Corps University
3070 Moreell Avenue
Marine Corps Combat Development Command
Quantico VA 22134

FUTURE WAR PAPER

Title:

Past as Prologue: Leveraging Lessons-learned from the Air to Facilitate Amphibious Forcible Entry in an A2AD Threat Environment

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF OPERATIONAL STUDIES

AUTHOR:
JOHN J. ROMA, MAJOR, UNITED STATES MARINE CORPS

AY 2014-15

MENTOR: DR. WRAY R. JOHNSON
APPROVED: [signature]
DATE: 10 Feb 2015

The 2014 *Joint Concept for Entry Operations* (JCEO) is the latest vision of how the Joint Force will conduct entry operations in the future operating environment. In consonance with the previously published *Joint Operational Access Concept* (JOAC), JCEO re-affirms, as one of three foundational future trends, the dramatic improvement and proliferation of anti-access and area-denial (A2/AD) weapons and technology. Of the various threats the Joint Force can expect to encounter in such an environment, one of the gravest and most prolific will be the use of Anti-Ship Missiles (AShMs), specifically targeting platforms such as aircraft carriers and amphibious assault ships which are essential to entry operations. As such, the United States Navy and Marine Corps must capitalize on past lessons learned in penetrating hostile Integrated Air Defense Systems (IADS) and leverage existing naval decoy technology and obscurants as a means to facilitate forcible entry operations in an A2/AD threat environment.

The components of a modern IADS are remarkably similar to those needed to employ AShMs, and for somewhat obvious reasons—the former relies heavily on the use of missiles to accomplish its task. The components, broadly categorized, are sensors, data fusion and command centers, the weapons themselves, and communication nodes. To degrade and neutralize such a system, the goal of the attacker is to detect a weakness in the system and to target this component by means of an asymmetrical advantage such as stealth technology to evade sensors, anti-radiation missiles to target launch sites, and electronic warfare to disrupt communication nodes. Ideally, this action occurs "left of launch," which is to say before the missile fires and achieves a distinct advantage vis-à-vis its target, which must now rely upon countermeasures.

Without the benefit of asymmetry, the attacker is at a distinct disadvantage when forced to rely on countermeasures alone. A particularly instructive historical example is the sequence of events that occurred in Israel leading up to the June 1982 "First Lebanon War." After routing the combined air forces of Egypt, Jordan, and Syria during the 1967 Six Day War, Israeli Air Force (IAF) pilots found themselves confronting Egypt and Syria again during the 1973 Yom Kippur War. This time, however, the IAF faced a Soviet-designed IADS with little to no opportunity for shaping as the Arab attack achieved near complete strategic surprise and Israeli ground forces were in need of immediate close air support in the Golan Heights and on the Sinai Peninsula. While Israel was ultimately victorious in this conflict, the IAF lost 50 aircraft during the first three days of fighting-- an unsustainable rate of loss had the conflict continued. Recognizing that the surface-to-air missile (SAM) threat had evolved, Israeli operational artists applied critical thinking to the problem at hand and devised a better way to operate in light of the changing circumstances.

Heading into the 1982 First Lebanon War, IAF pilots again faced Syrian SAM batteries that had been placed in the Bekaa Valley of Lebanon. This time, however, the IAF employed several approaches to deal with the IADS threat. One of the more novel techniques used by the IAF was to lead strike packages with Mastiff drones equipped with radar decoy devices. These drones enticed Syrian radars to activate and fire off some 57 SA-6 missiles. With the launch and command and control sites now uncovered, 19 SAM sites were destroyed over the following two hours by fighters flying in trace of the drones, with no loss of IAF aircraft.[1]

It is entirely conceivable that at some point in the foreseeable future the United States could also find itself embroiled in conflict where forcible entry is required without the benefit of a lengthy shaping period. While a great deal of empirical knowledge exists as to how to overcome such circumstances in the air, operating at sea in the face of a sophisticated enemy missile threat remains largely a theoretical endeavor. An opportunity exists to leverage a proven technique such as the use of decoys; however, one must first possess a basic working knowledge of the threat.

AShMs break down into two categories: Anti-Ship Ballistic Missiles (ASBM) and Anti-Ship Cruise Missiles (ASCM). ASBMs, such as the Chinese DF-21 (See Figure 1 in the appendix), are theater-range ballistic missiles designed to target large ships on the move and serve as anti-access weapons-- which is to say they inhibit movement to a particular theater. The DF-21 fires from a ground-based mobile launch platform and has a range upwards of 2,000 kilometers (1,080 nautical miles). The missile's low radar signature, reported speed of Mach 10, and powerful, maneuverable warhead has it billed as a "carrier killer" and naturally of great concern to the Navy.[2]

ASCMs, unlike their ballistic counterparts that follow a high-trajectory of flight, skim close to surface of the water at subsonic speeds in an attempt to evade a defender's radar and can be ground-based, launched from surface combatants, or air-delivered. These serve as area-denial systems, which impede maneuver within a theater. Amongst the most capable of these are Russian-made SS-N-22 "Sunburn" and SS-N-27 "Sizzler" missiles, both of which have been exported to countries such as Iran and China. The Chinese variant of this missile, the YJ-18, skims above the surface of the water for 180 kilometers (97 nautical miles) while traveling at Mach 0.8 before accelerating to Mach 3.0 to for the final 40 kilometers (22 nautical miles) of flight. The missile combines supersonic speeds with a series of evasive maneuvers in an attempt to both limit reaction time and frustrate targeting efforts. Additionally, the missile can be equipped with an electronic-pulse warhead, designed to disable a ship's electronic systems (e.g., Aegis) within 50 meters of detonation.[3] Both ASBMs and ASCMs are guided by means of radar-seeking (RF), infrared (IR), and electro-optical (EO) means of control, or a combination thereof, with the most common being RF-guided.

The implications that an effective anti-access threat poses to the Joint Force are substantial. Simply locating DF-21 launch sites poses a significant challenge due to their mobility. Furthermore, the DF-21 has a maximum effective range that is two and one-half times the unrefueled combat radius of an American carrier air wing, limiting the role of carrier-based aviation during shaping operations.[4] Should the anti-access threat be neutralized, friendly forces will still have to contend with the area-denial systems that could menace a forcible entry operation such as an amphibious assault as it closes towards its objective.

As with the DF-21, ASCMs such as the SS-N-27 will prove difficult to locate. Russian firms marketing these missiles offer an innocuous-looking cargo container known as the "Club-K" that serves as cover for the Transporter-Erector-Launcher (TEL) and can be inconspicuously fired and guided from the container while located on a truck, train car, or container ship (See Figure 2 in the appendix). Further complicating the problem is the high likelihood of a mass volley of fire. With the cost of a DF-21D model estimated at $5-10.5 million per copy, China could potentially build 1,227 DF-21D's for every aircraft carrier the United States builds.[5] This issue is only that much more compounded when the less-expensive ASCMs are considered. Of the hundreds of missiles that can potentially be fired, only perhaps one needs to penetrate the defense system to significantly alter the relative combat power of forces in a given theater. Given these factors and the current trend line, interdiction left of launch of all threat missiles is very unlikely. However, as the Israelis learned in 1982, sometimes presenting one's enemy with the very target he is looking for is a better way to fight.

The U.S. Navy currently incorporates the use of decoys which mimic the radar signatures of ships as countermeasures against incoming threat missiles. The most common is the MK 53 Decoy Launching System, also known as "Nulka" (See Figure 3 in the appendix). The Nulka is a missile which simulates the radar return of a large ship and is fired to seduce an incoming RF-guided missile away from its intended target. The Navy has also awarded a contract for the MK 59 system to be outfitted on destroyers and frigates.[6] Unlike the MK 53, which is considered an "active decoy" because it operates autonomously after launch, the MK 59 is a "passive decoy" that, once deployed, inflates and floats in the water away from the ship (See Figure 4 in the appendix). As countermeasures, both systems are defensive in nature and employed in the final stages of the incoming missile's targeting kill-chain.

To capitalize upon the Israeli experience in the 1982 First Lebanon War, one would have to find a way to employ such a capability during designated shaping operations; or at a minimum as a hasty screen in front of the force charged with conducting the forcible entry if time is limited. The U.S. Air Force has developed the means to do so, currently fielding the ADM-160 MALD, or Miniature Air-Launched

Decoy missile. This missile can be programmed to simulate the radar signature of any designated aircraft and is fired ahead of the strike package in the same manner the Israelis employed the Mastiff drones. Ideally the Nulka would be able to perform this function for the Navy; however, the key difference is one of speed. While missiles fly at speeds equivalent to that of jets and are thus convincing decoys, the disparity in velocity between a Nulka missile and a ship would be readily apparent to even the most poorly trained AShM operator. Thus, what is needed is a better way to leverage existing technology and investment in additional capabilities to facilitate Joint Entry Operations.

The JCEO acknowledges the potential value of decoys in support of establishing a lodgment ashore, stating: "Unmanned decoys can aid in drawing adversary fire away from critical manned assets, or in deceiving the adversary as to the critical point of attack."[7] In order to more fully develop this concept, it is perhaps most useful to begin by exploring how existing technology could be repurposed to achieve the desired effect in an A2AD threat environment. An asset such as the floating decoy that the MK 59 system employs serves as a good place to begin.

Possessing the ability replicate the radar cross-section of any particular ship, the MK 59 decoy could facilitate both shaping and decisive operations against a less-sophisticated enemy within the context of an area-denial threat. In support of shaping operations, these decoys could be sown along a hostile coastline by air, sub-surface, or stealthy surface platforms. Once inserted and active, these systems would facilitate a "spike and strike" targeting construct. Ideally, the presence of these decoys would prompt a launch from enemy ASCMs, uncovering those positions and exposing them to counter-strike. Given that the vast majority of ASCMs are RF-guided, this targeting construct stands a reasonable chance of success. For a more sophisticated enemy with redundant sensors, the mere presence of MK 59 decoys may not in and of themselves elicit launch, but they are likely to warrant a more thorough interrogation of the potential target via other means available. This would presumably expose other components of the system such as the sensors, communication nodes, and data fusion and command centers to potential strike.

Also useful in such a scenario is where the proverbial dog might not bark, to use a Sherlock Holmes analogy. The defender of a coastline is at a distinct disadvantage in the sense that he is essentially forced to try and defend everywhere, thus making him weak everywhere. Even with over two years to prepare the Atlantic Wall and some 850,000 troops in France as of June 1944, Hitler was unable to prevent the Allied landing on the Cotentin Peninsula. The Joint Force can therefore probe or even assault where decoys draw little or no response, greatly contributing to Joint Intelligence Preparation of the Operating Environment.

Once the lodgment area has been selected, altering employment of the MK 59 decoy can facilitate the penetration as well. Ideally, enemy TEL sites will have been reduced via shaping operations and any remaining assets will be hesitant to engage due to potential exposure to strike. To safeguard against the possibility of additional ASCMs, or should the situation not permit deliberate shaping operations, the entire sea echelon, transport, and landing areas could be littered with active Mk 59 devices. Similar to the manner in which computer denial of service attacks occur, the idea is to saturate the enemy system and "dirty" the battlefield as much as possible with an overabundance of targets. Threat missiles that possess redundant means of guidance such as IR and electro-optical means will probably still be distracted, providing crucial seconds for a system such as Aegis to operate as designed.

With no change needed to current design, only method of employment, the MK 59 provides a cost-effective measure that would greatly strengthen the decoy concept as outlined in the JCEO. The next logical step, then, is to incorporate this technology into Unmanned Surface Vehicles (USV). A 2013 study performed by the RAND Corporation, entitled *U.S. Navy Employment Options for Unmanned Surface Vehicles,* noted that USVs are highly suitable and advocated their potential effectiveness in overcoming A2/AD challenges. The study pointed to some 63 models of USVs on the market, the vast majority manufactured in the United States. The models ranged in size from less than three meters in length to 41 meters, or roughly the equivalent size of a Landing Craft, Utility (LCU).[8] These USVs might be configured to confront the AShM threat in a more sophisticated A2AD threat environment.

At the lower end, a USV of three meters or less would be suitable to carry an RF decoy device (See Figure 5 in the appendix). Such an asset would likely still operate mainly in the domain of an area-denial threat and accomplish the missions previously outlined for the MK 59. The immediate benefit is that this USV can travel at speeds akin to the ship they are intended to mimic and thus provide a much more convincing decoy. Unlike the MK 59, which may or may not be lost due to hostile fire, the USV is an asset that friendly forces can recover and reuse. Should the decoy be targeted by an incoming missile, the operator can simply "remove" the target after launch by killing the RF signal emitting from the device.

In support of reconnaissance efforts in a high-threat environment or when clandestine action is required, micro-USVs benefit greatly from being self-deployable. A micro-USV could be launched from a mother ship operating in international waters and proceed to the coastline with a very small "signature" of its own before pinging in support of collection and targeting efforts. In support of an amphibious assault or raid, such devices could conduct reconnaissance of the landing area to include "proofing" of lanes from the transports to the selected landing zones. Additionally, such an asset adds greatly to the forms of maneuver that can be employed, giving the micro-USV considerable value in support of operational-level deception. Assets pinging to resemble various ships that might be found in a sea echelon or landing area can act as fixing forces while the actual assault force conducts envelopment or turning of the objective. Conversely, these assets could simulate the latter two forms of maneuver while the actual assault force conducts penetration of the hostile coastline.

With regard to a more sophisticated enemy force with greater sensor capability such as over-the-horizon radar, a naval task force could maintain a safe distance from the threat and launch these decoys forward with additional assets such attack aircraft and helicopters. These aircraft, flying in the proximity of the decoy force, would provide the additional signatures expected to be found in the vicinity of an actual naval task force. Thus, even assets this small can have a positive effect on facilitating operations in the anti-access realm. A screening force of RF-capable micro-USVs could be sent ahead to conduct reconnaissance of a critical choke point such as the Straits of Hormuz in order to proof the lane of a potential AShM threat before ships make their way to the Persian Gulf.

A mid-sized USV, akin in size to a seven to eleven meter Rigid Hull Inflatable Boat (RHIB), could facilitate operations in a more sophisticated A2AD threat environment (See Figure 6 in the appendix). Below the surface, this decoy could tow acoustic equipment such as the AN/SLQ-25 "Nixie" system capable of emitting simulated ship noise (See Figure 7 in the appendix). Above the surface, a decoy of this size would be capable of carrying equipment such as the MK 36 SBROC (Super Rapid Bloom Off-Board Countermeasures) system capable of firing chaff and infrared countermeasures to attract IR-guided missiles (See Figure 8 in the appendix). Should the decoys fail to elicit a response, this force would still be well positioned as a screening element between the friendly force and the threat missile launch site. Employment of these assets may also entice a threat missile such as the YJ-18 to prematurely enter its supersonic stage of flight, again enabling a system such as Aegis to react as designed.

While a variety of decoys are currently available to attract incoming RF-guided missiles as well as "spoof" sensors over the horizon, perhaps the most difficult hurdle to overcome will be missiles outfitted with optical means of control. Within the context of an area-denial threat, the 2006 strike of the Israeli missile corvette INS *Ahi-Hanit* provides an interesting case for study. While operating roughly ten nautical miles off the coast of Beirut, the *Hanit* was struck by a Hezbollah anti-ship missile. The weapon was reported to have been a Chinese C-802 variant that is capable of several dual guidance configurations to include television and infrared imaging and would have reached the ship in less than 60 seconds. The Israeli Navy claims that the ship's missile defense system was intentionally disabled due to lack of intelligence of such a threat and the close proximity of IAF aircraft that might inadvertently trigger the system.[9]

U.S. naval vessels would be unlikely to commit such an error when conducting forcible entry operations; however, a mass volley of anti-ship missiles could overwhelm a ship's defenses. While the Aegis system is capable of tracking a vast amount of targets, a finite amount of countermeasures are available. This is particularly troublesome when considering the 20 nautical mile operational range of the current Marine Corps Amphibious Assault Vehicle (AAV). As the range of threat missiles continues to increase, simply ceding the ability to close with the coastline and rely instead upon platforms such as the V-22 "Osprey" and the Landing Craft, Air Cushioned (LCAC), is a risky proposition. No combination of these assets will be able to land and sustain a force in sufficient strength to conduct prolonged combat operations ashore, let alone a Marine Expeditionary Brigade, which is doctrinally the smallest Marine Air-Ground Task Force capable of forcible entry operations.

One technological development that shows a great deal of promise in overcoming such a challenge is in the field of obscurants. As Commander Scott Tait, USN, points out in his well-written 2011 *Proceedings* article entitled "Make Smoke!", the Navy relied heavily on the use of smokescreens in the past to facilitate landings, most notably during World War II. The latest innovation in this regard, originally developed by the U.S. Army, is known as the M56 "Coyote" system (See Figure 9 in the appendix). This is a smoke generator mounted on a High Mobility, Multipurpose Wheeled Vehicle (HMMWV) which releases a material known as "Pandarra Fog". At first glance, it resembles any other smokescreen; however, it actually consists of carbon-fiber materials that can release visual, IR, and RF obscurants that incoming missiles are unable to see through.[10] With no change to existing technology, M56 systems could be "pre-boated" aboard LCACs to enable amphibious shipping to close the distance from the Close Support to the Transport Area. The LCACs would then be followed by subsequent waves of AAVs, modified to release Pandarra Fog as well.

If the capability to employ Pandarra Fog was added onto a mid-sized USV, the threat to the LCACs would be significantly reduced and the possibility for operational deception greatly enhanced. In support of a penetration, a stealthily designed platform such as that in Figure 8 could precede the assault force at night along a course predetermined by GPS in near electronic silence while releasing obscurant in its wake to screen follow-on vessels. If stealth is not possible, the USV's RF and acoustic emitters could easily be configured to make the platform resemble something as innocuous as small fishing vessels returning to port. In further support of operational deception, a mid-sized USV emitting an obscurant such as Pandarra Fog presents the unique opportunity to take advantage of the selectable nature of the obscurant against a more advanced enemy possessing a greater variety of sensors and more sophisticated dual-guidance missiles. For instance, in support of an envelopment, the actual assault force could remain shrouded behind an obscurant blocking all emissions. The decoy force would be arrayed in two layers. The first layer would release visual and IR obscurants while allowing RF signals to pass through the shroud. A second layer of decoys emitting RF signals would then occupy a position behind this force. While the operator of the AShM would be unable to confirm the target by visual identification, the presence of an RF signal would likely elicit a launch, particularly if the operator makes the assumption that the obscurant is a normal smokescreen. This would uncover the launch site and expose it to counter-strike while facilitating the maneuver of the actual force ashore.

Finally, there is the matter of addressing the gravest anti-access threat: a scenario involving ASBMs supported by a constellation of real-time satellite imagery in support of a sophisticated command and control system. Such an A2AD environment may soon exist in the South China Sea. The most plausible response to dealing with such a threat is to knock down or jam the adversary's satellites, which is entirely plausible in an all out wartime situation. Short of such action, when politically infeasible or (more likely) in response to a surprise attack against an asset such as an aircraft carrier that would mark the commencement of hostilities, large-scale USVs capable of emitting Pandarra Fog could play a vital role in both force protection and ensuring theater access. In 2014, the Navy conducted tests of vessels emitting Pandarra Fog aboard ships south of Guam (See Figure 10 in the appendix), with promising results.[11] However, a glaring weakness is the exposure of the covering ships themselves that are releasing the obscurant material. A contingent of large-scale USVs capable of operating in heavy seas could form a protective barrier around the critical asset to be protected without risk to manned assets. As Commander Tait points out, the material itself is relatively inexpensive at $1,000 a box, and six of these systems, each releasing eight boxes of material, could cover an area of several square kilometers within minutes.[12] This shroud would be in place well before the estimated 12 minutes a threat missile such as the DF-21 would need to cover its maximum effective range at Mach 10.[13]

The U.S. Navy is also pursuing directed-energy weapons such as the Laser Weapon System (LaWS) currently undergoing sea-trials aboard the USS *Ponce*. With the speed to intercept any threat missile and a theoretically endless supply of "ammunition," this leap in technology represents a potential revolution in military affairs in the A2AD realm. While additional testing is needed to determine the feasibility of employment in all weather scenarios, LaWS holds great promise for the future. That said, there are existent technologies that can be used now to facilitate forcible entry. As history has demonstrated, reliance upon countermeasures alone is rarely a winning proposition given the speed of technological change.

---

1 Rebecca Grant, "The Bekaa Valley War," *Air Force Magazine*, June 2002. http://www.airforcemag.com/magazinearchive/pages/2002/june%202002/0602bekaa.aspx?signon=false.

2 U.S. Naval Institute, "Report: Chinese Develop Special 'Kill Weapon' to Destroy U.S. Aircraft Carriers," *Proceedings*, March 2009. http://www.usni.org/news-and-features/chinese-kill-weapon.

3 Deagel Online, s.v. "YJ-18," accessed 4 Jan 2015, http://www.deagel.com/Anti-Ship-Missiles/YJ-18_a002884001.aspx

4 Naval Strike Forum, *Aircraft Carrier (In)vulnerability: What it takes to successfully attack an American Aircraft carrier* (The Lexington Institute, 2001)

5 Andrew S. Erickson, *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategic Implications* (Washington, DC: The Jamestown Foundation, 2013), 138.

6 U.S. Navy, "Decoy Launch System Installed Aboard USS Ramage," news release, December 17, 2013, http://www.navy.mil/submit/display.asp?story_id=78320

7 Joint Chiefs of Staff, *Joint Concept for Entry Operations.* (Washington, DC: April 7, 2014), 21.

8 National Defense Research Institute, *U.S. Navy Employment Options for Unmanned Surface Vehicles (USVs)* (Washington, DC: The RAND Corporation, 2013).

9 Kirk Spencer and Trent Telenko, "An Analysis of the Hezbollah Anti-Ship Missile Strike: The Attack on INS Ahi-Hanit," Israelbehindthenews.com, July 25, 2006, http://israelbehindthenews.com/an-analysis-of-the-hezbollah-anti-ship-missile-strike-the-attack-on-ins-ahi-hanit/4892.

10 Commander Scott Tait USN, "Make Smoke!," *Proceedings*, June 2011, 58-63.

11 Erik Slavin, "Navy looks to advancements in 'fog of war' for missile defense," *Stars and Stripes*, July 3, 2014. http://www.stripes.com/news/navy-looks-to-advancements-in-fog-of-war-for-missile-defense-1.291850.

12 Tait, *Make Smoke*, p. 61.

13 USNI, Report: Chinese Develop Special 'Kill Weapon' to Destroy U.S. Aircraft Carriers.

Appendix

Figure 1: Chinese DF-21 ASBM

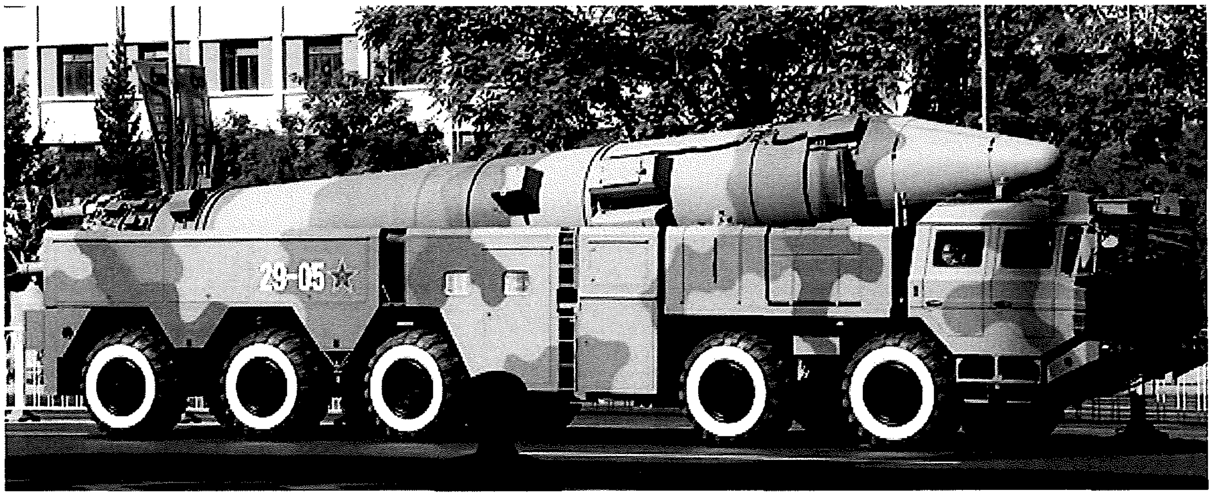


Figure 2: Russian Club K Container Missile System

Figure 3: MK53 Nulka Decoy

Figure 4: MK-59 Decoy Deployed

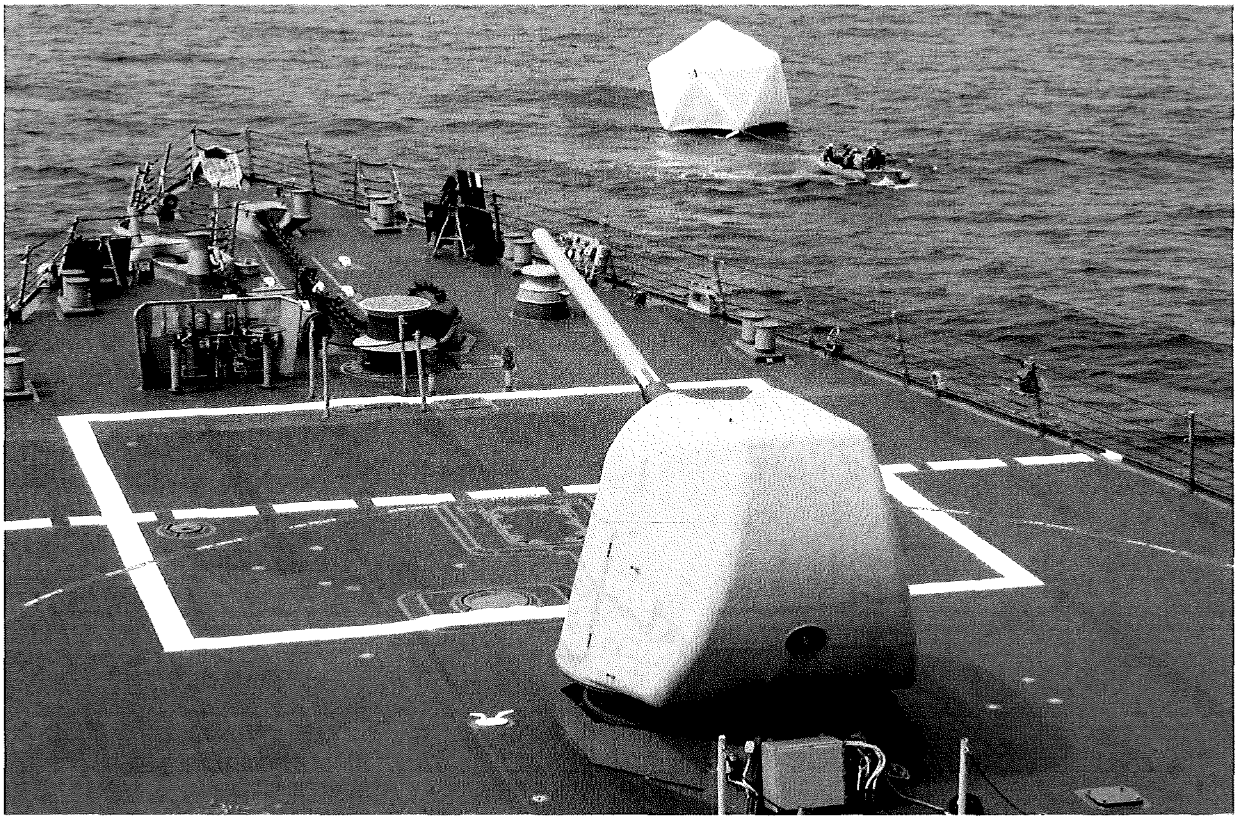


Figure 5: General Dynamics 3.5 Meter USV

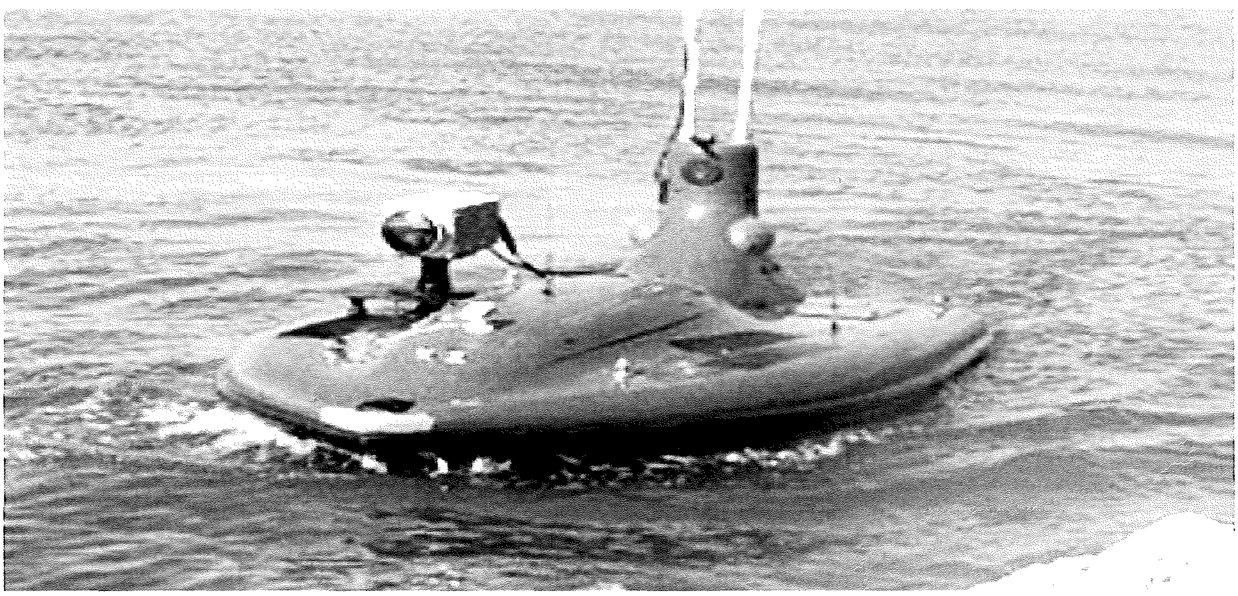


Figure 6: AAI Textron Mid-Sized USV

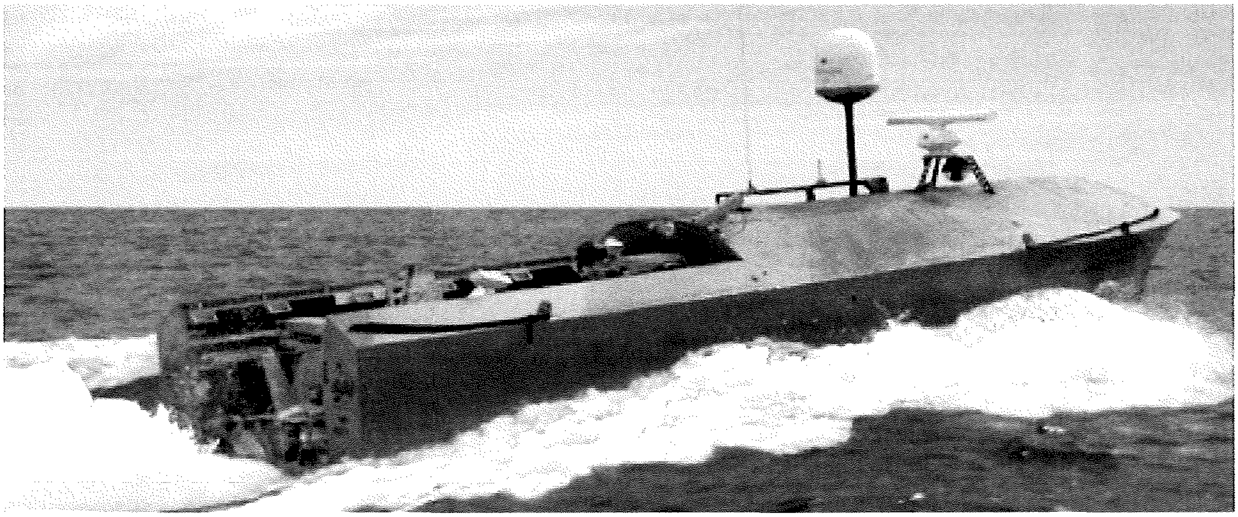


Figure 7: AN/SLQ-25 Nixie

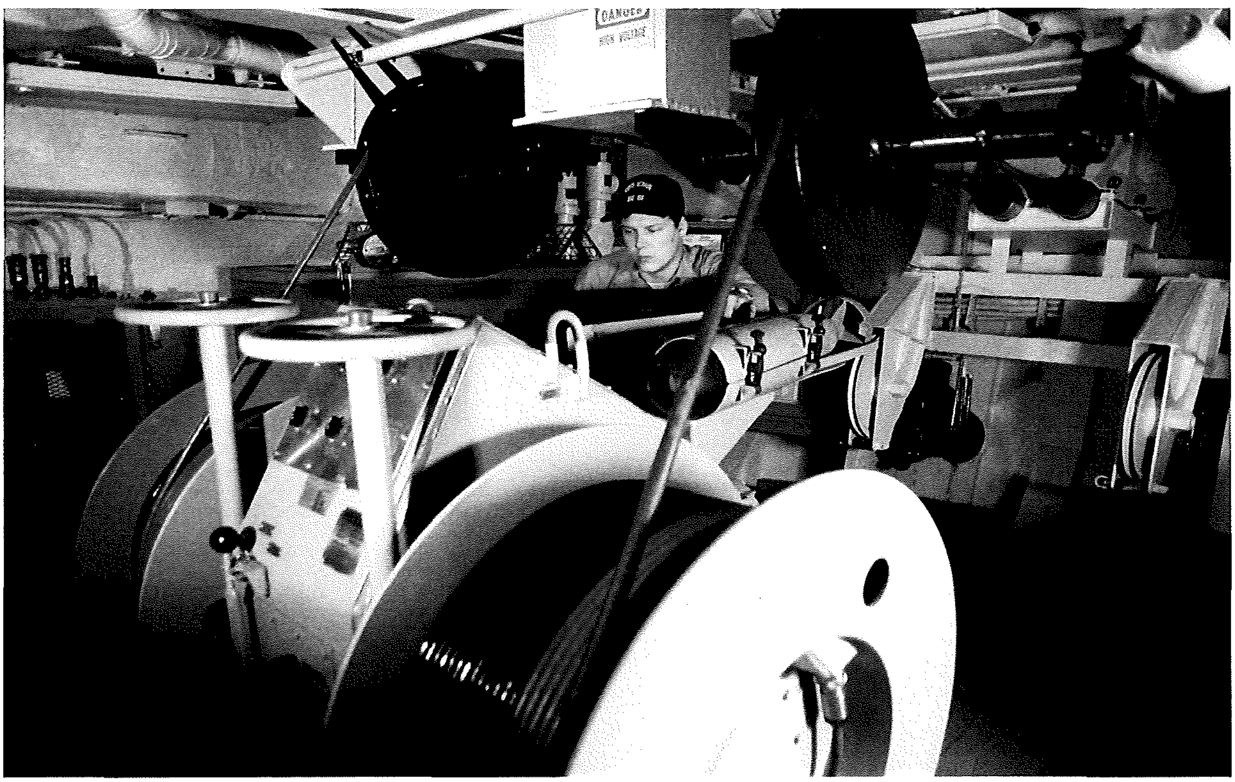


Figure 8: MK-36 SRBOC

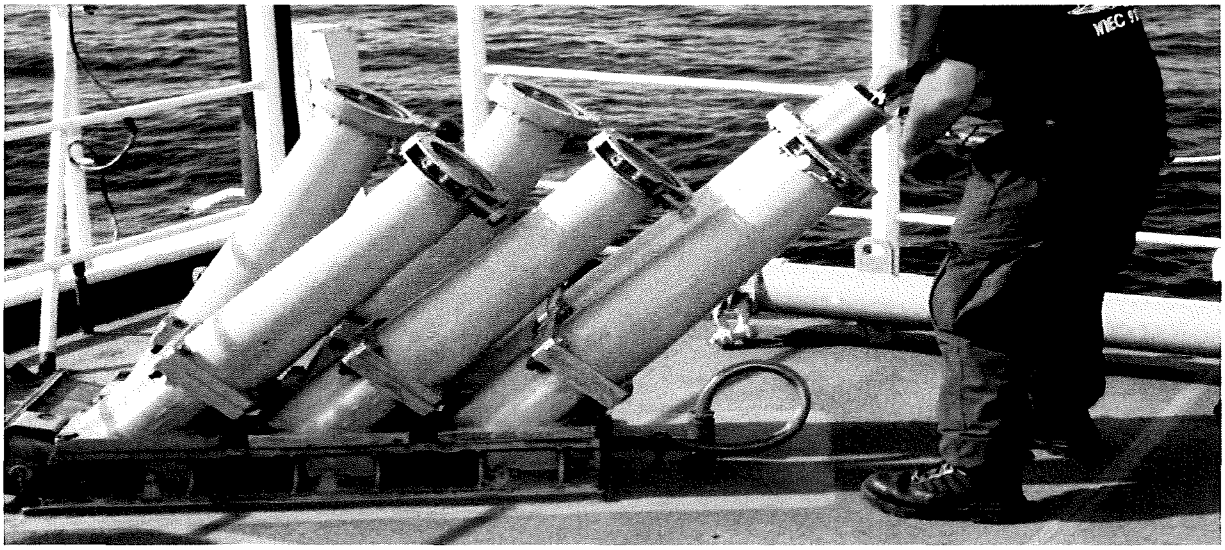
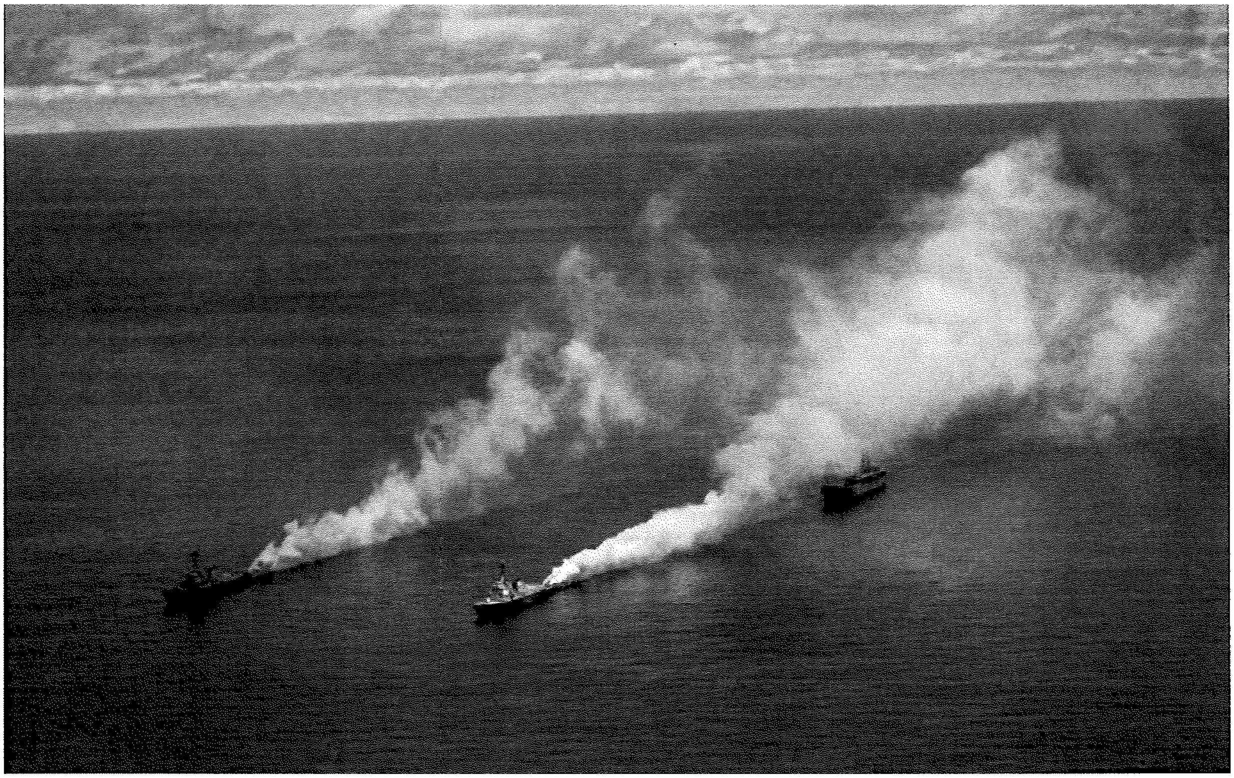


Figure 9: M56 Coyote

Figure 10: June 2014 Pandarra Fog Sea Trials



Bibliography

AirSea Battle Office. *AirSea Battle: Service Collaboration to Address Anti-Access and Area Denial Challenges*. Washington, DC: May 2013.

Erickson, Andrew S. *Chinese Anti-Ship Ballistic Missile (ASBM) Development: Drivers, Trajectories, and Strategic Implications.* Washington, DC: The Jamestown Foundation, 2013.

Grant, Rebecca. "The Bekaa Valley War." *Air Force Magazine*, June 2002. http://www.airforcemag.com/magazinearchive/pages/2002/june%202002/0602bekaa.aspx?signon=false.

Joint Chiefs of Staff. *Joint Concept for Entry Operations.* Washington, DC: April 7, 2014.

National Defense Research Institute. *U.S. Navy Employment Options for Unmanned Surface Vehicles (USVs).* Washington, DC: The RAND Corporation, 2013.

Naval Strike Forum. *Aircraft Carrier (In)Vulnerability: What it takes to successfully attack an American Aircraft carrier.* Washington, DC: Lexington Institute, 2001.

Slavin, Erik. "Navy looks to advancements in 'fog of war' for missile defense." *Stars and Stripes*, July 3, 2014. http://www.stripes.com/news/navy-looks-to-advancements-in-fog-of-war-for-missile-defense-1.291850.

Tait, Scott. "Make Smoke!" *Proceedings*, June 2011.

Tangredi, Sam J. *Anti-Access Warfare: Countering A2/AD strategies.* Annapolis, MD: Naval Institute Press, 2013.

U.S. Naval Institute. "Report: Chinese Develop Special 'Kill Weapon' to Destroy U.S. Aircraft Carriers." *Proceedings*, March 2009. http://www.usni.org/news-and-features/chinese-kill-weapon.