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14. ABSTRACT

The Marine Corps is rapidly advancing towards the Expeditionary Advanced Basing Operations (EABO) concept. Right now, the Marine Corps is wagering that the F-35 will be a "one size fits all" solution. Time and history have shown, especially when it comes to aviation, that these kinds of solutions are hardly solutions at all. The Marine Corps, if it wants to protect its EAB sites, needs to emphasize CAS assets in an EABO environment. The second aspect of this is if the Marine Corps addresses the limited amount of potential CAS platforms, then the ability to protect those platforms in a saturated radar environment becomes paramount. This leads to a need for more unmanned systems that can fulfill the EW role that the EA-6B "Prowler" used to provide. Another facet to the EABO fight is projecting power forward, and again, the F-35 stands poised to be up to the task in a slightly limited capacity. The weapons payload of the F-35 is severely limited due to its stealth capability and will leave it to use in different mission sets. The HMLA can supplement the number of weapons and sorties required to ease the responsibility off of the F-35.

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MASTER OF MILITARY STUDIES

The Marine Corps' Future of Attack and Utility Helicopters: Survivability Through Manned and Unmanned Teaming

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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Executive Summary

Title: The Marine Corps' Future of Attack and Utility Helicopters: Survivability Through Manned and Unmanned Teaming

Author: Major Jared Himes, United States Marine Corps

Thesis: This paper will present evidence that to make the EABO concept work, the Marine Corps needs the HMLA to conduct MUM-T to remain relevant, lethal, and survivable.

Discussion: The Marine Corps is rapidly advancing towards the Expeditionary Advanced Basing Operations (EABO) concept. This rapid movement, however, is overlooking some critical concepts to conducting EABO that need to be addressed. Failure to address these concepts will have dire impacts on the forces operating abroad. One such area that is not being addressed enough is close air support (CAS). Right now, the Marine Corps is wagering that the F-35 will be a "one size fits all" solution. Time and history have shown, especially when it comes to aviation, that these kinds of solutions are hardly solutions at all. The Marine Corps, if it wants to protect its EAB sites, needs to emphasize CAS assets in an EABO environment. The second aspect of this is if the Marine Corps addresses the limited amount of potential CAS platforms, then the ability to protect those platforms in a saturated radar environment becomes paramount. Failure to protect these platforms will only hamper the operation. This leads to a need for more unmanned systems that can fulfill the EW role that the EA-6B "Prowler" used to provide. Another facet to the EABO fight is projecting power forward, and again, the F-35 stands poised to be up to the task in a slightly limited capacity. The weapons payload of the F-35 is severely limited due to its stealth capability and will leave it to use in different mission sets. The HMLA can supplement the number of weapons and sorties required to ease the responsibility off of the F-35.

Conclusion: The AH-1 and UH-1 have proven themselves since the Vietnam War to be viable platforms. Speak with any infantry Marine during the recent Iraq or Afghanistan Wars, and they will undoubtedly praise the contributions that these platforms have made. EABO will require Marines to be forward with little support from artillery, tanks, and close air support assets. The H-1 helicopter is small and can land almost anywhere without having to have a prepared surface. The HMLA community is also familiar with forward arming and refueling point (FARP) operations in austere environments that are well suited to be side-by-side with the very Marines that they are meant to protect. With unmanned aerial vehicles that can conduct radar jamming, the HMLA will be better able to perform its mission, which in turn will support the Marines on the ground in conducting their missions.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS, COMMAND AND STAFF COLLEGE, OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

Table of Contents

Page

Preface

Inspiration for writing this paper came from an email I sent to General Neller before he retired and before I arrived at Command & Staff College. I asked if he thought there was a problem within the Marine Corps that he could not solve and that a dedicated mind could find a solution to while in a Marine Corps school environment. General Neller was kind enough to reply and suggested I research how the HMLA could join manned and unmanned aviation assets or even an unmanned wingman together. Later, I read the *CPG* by General Berger and saw a capability gap in the EABO design, and through this paper, I aim to share my thoughts and research on them. While my opinions and analysis may sound denigrating to the F-35, I am trying to advocate that we are asking the F-35 to do too much and that the H-1 helicopters that we currently have can offset the burden when conducting EABO. Both of these are revolutionary concepts in their own right and are worthy of praise. I see a capability gap in both and am proposing a solution that I think the Marine Corps should look further into solving. Additionally, my intention in this paper is to act as a springboard for people to act upon as the Marine Corps moves forward with EABO. MUM-T is a relatively new concept with infrequently used definitions, and capabilities for it in the future are up for much discussion and are beyond the scope of this paper.

I want to thank the staff of Marine Corps University, for providing an excellent and challenging learning experience, particularly LtCol Dan Micklis, Dr. James Joyner, and Dr. Anne-Louise Antonoff. I also wish to thank Dr. Brandon Valeriano for his guidance, patience, and advice as my MMS mentor. Most importantly, I want to thank all the Marines, sailors, soldiers, and airmen whom I have had the honor to serve with, and I hope to cross paths with you again.

INTRODUCTION

The Commandant of the Marine Corps (CMC), General Berger, has put the Marine Corps on notice with his *Commandant's Planning Guidance (CPG)* published in 2019 that will have some significant institutional changes. Previous Commandants have discussed the Marine Corps' need to evolve and conduct operations such as Expeditionary Advanced Basing Operations (EABO)[1]. General Berger is in a unique position to make this change because the Marine Corps is no longer centrally focused on the conflicts in the Middle East, and by publishing his CPG, he has ensured that he will not waste his opportunity.

One example of the Marine Corps already changing is with the purchase of the MQ-9 unmanned aerial vehicle (UAV), which was previously reserved for other services. This UAV is going to be a force multiplier in a traditional sense by providing intelligence, surveillance, and reconnaissance (ISR). However, the requirements the Marine Corps is seeking for unmanned capabilities is not enough, which will be discussed. The Marine Light Attack Helicopter (HMLA) squadrons, too, are in a fortunate situation to change for the better and still be in keeping with the CMC's guidance. One aspect of that change needs to be in the electronic warfare (EW) department and through communicating their ability to support EABO and their already existing expeditionary functions. The retirement of the EA-6B "Prowler" has shown to create a capability gap that is in dire need of being filled. EW is one of the six functions of Marine Aviation, and there has been little to no replacement of the EA-6B to pick up the role. The F-35 is touted to be able to do EW, which is true, but not to the same degree as the EA-6B could, given that the F-35 does not carry an ALQ-99.[1]

[1] Most of the data regarding the F-35 is on the classified realm, and therefore for purposes of this paper, the discussion will be limited to the unclassified realm.

This paper will detail the lethality of an integrated air defense system (IADS), how suppression of enemy air defense (SEAD) is conducted to combat IADS, a historical example of how SAMs can affect aviation operations, and wargaming results conducted with the Marine Corps Warfighting Lab (MCWL). Additionally, the HMLA will be examined in its current state regarding aircraft and capabilities, and how MUM-T can be incorporated to conduct aviation operations in support of the GCE. While focusing on MUM-T, for the uses of this paper, the discussion centers around unmanned assets that are either controlled by a pilot's tablet, by a control station, which is currently in use today, or controlled via voice from a pilot like commands given to a cell phone. The later will be more prolific as artificial intelligence (AI) is further developed. This paper will present evidence that to make the EABO concept work, the Marine Corps needs the HMLA to conduct MUM-T to remain relevant, lethal, and survivable.

PROBLEM STATEMENT AND BACKGROUND

It is no mystery that the EA-6B was a "national" asset, so requesting one of these planes to support one's mission was often difficult, if not impossible. However, when mission necessity required an EW platform, the EA-6B was a capable platform for conducting the EW mission, with the added benefit being that the Marine Corps already owned it. As the focus moves away from the Middle East and to near-peer adversaries, Marine aviation will need to be able to fulfill the EW gap on their own without overly relying on the Joint Force. This holistic approach has been the cornerstone of making the Marine Air Ground Task Force (MAGTF) relevant. This precept also made Marine aviation significant from its genesis. Looking further down from the strategic level to the tactical level, the HMLA will be expected to support the ground combat element (GCE) in the future as it has always done regardless of the environment against a near-

peer adversary. Nevertheless, the consequences of not respecting the surface-to-air missile (SAM) threat become all too clear.

For more than two decades, the United States has enjoyed air superiority with little to no threat to manned aircraft. Though this has allowed for a safer manned aircraft environment, it also added a level of complacency since there was no concern about a complex IADS. The result was a force with a questionable capability of conducting operations in complex environments against enemy IADS. This example was seen when fighting organizations like the Taliban that had a minimal anti-air ability. The way forward is for all aircraft to be capable of conducting EW for themselves, which has some severe drawbacks, which will be discussed. The only platforms with a dedicated role to EW, in the sense of providing radar jamming, are the EA-18G and, to some degree, the F-35. There is an argument to be made that EW is carried out by other platforms such as the UH-1Y, but for the purposes of the paper, the focus will be on radar jamming and attrition of SAMs. The advancements made by Russia and China with their SAM systems have allowed these systems to become widely proliferated and relatively cheap in comparison to the airplanes that they are meant to target. Modern systems like the SA-21 (S-400)[2], a medium to long-range missile system, and the SA-22[3], a short-range missile system, when networked together to form an IADS make conducting flight operations against technologically advanced adversaries extremely difficult.

UNDERSTANDING IADS

When assessing the benefits of MUM-T in the EW environment, it is crucial to understand what IADS are and how they operate. IADS create a layered buffer zone of differing range SAMs to deter different types of aircraft from operating in their airspace. They do this by encompassing a package of short, medium, and long-range missiles that operate in different radio

wavelengths. When this information is brought to a command & control (C2) node, the data gives the enemy a holistic picture of the airspace, and then based upon the appropriate weapon to target match, a decision is made to attrite the asset. The critical difference from early SAMs to present-day ones is their communication networks and radar algorithms, which have changed from being analog to digital and are very adept in detecting aircraft. For example, the SA-21 is designed to be used against targets such as cruise missiles, tactical and strategic missiles, low-signature stealth aircraft, airborne warning and control system (AWACS) type aircraft, and standoff jammers.[4] The ability to target standoff jammers will come back to the discussion later. The system employs a multimode phased-array radar and signal processor system, advanced highly automated crew stations, and highly advanced target-engagement algorithms with a variety of missile types that create a multi-layered defense.[5] As a fourth-generation system, what this means is that conducting flight operations when these systems are present is very prohibitive and difficult to defeat. As will be shown later, the SA-6 is a first-generation SAM and had a significant impact on the Yom Kippur War. Modern systems are more lethal and require new ways of defeating them. Stealth technology is one such solution but is inordinately expensive, as is seen with the F-35, which holds a price tag of around 100 million dollars per aircraft.[6] Stealth technology has other shortcomings not just associated with cost but also the amount that can be produced, which is slow, and the ability to repair them should they receive battle damage, which drives the necessity for other solutions. In fact, Naval Air Systems Command (NAVAIR) estimates that the F-35 will require 50 direct maintenance man-hours per flight hour, which is more than three times the current rates of the USMC aviation fleet.[7] The higher maintenance man-hours mean the number of sorties capable of being generated will go down, resulting in other platforms needing to pick up the sortie generation loss. When assessing the lethality of

SAMs and the sorties needing to be generated by looking at history, much can be gleaned on the need to recognize the threats and combat them appropriately.

LITERATURE REVIEW

The Joint Force is looking at a multitude of solutions in combating IADS. Chaff is one solution that is designed to clutter the radar picture temporarily with multiple returns. With the advancements made in SAMS, chaff is becoming less useful in defeating these systems, which leads to finding other solutions such as stealth. Stealth technology aims to reduce the radar cross-section (RCS) so that a radar is unable to detect the object. This kind of technology is costly and takes an immense amount of time to complete a single aircraft. Another approach is through various methods of suppression of enemy air defense (SEAD). SEAD, while not new, is often a complicated mission to perform. SEAD is neutralizing, destroying, or temporarily degrading surface-based enemy air defenses by destructive or disruptive means.[8] The methods used can be surface to surface fires such as employing artillery on the air defense system, and air to surface methods such as with an AGM-88, which seeks out radar energy as a homing device to destroy the radar. Another approach would be through jamming the radar itself with something like the ALQ-99. This system attempts to obstruct the radar energy at its source, obscuring the "picture" of the radar, making the detection of aircraft more difficult. Aircraft are currently being fitted and tested with jammers such as the Intrepid Tiger pods. The intent behind these pods is to provide every aircraft with the ability to jam a radar for itself. There are a couple of shortcomings to this approach. The capabilities and limitations of this system are mostly on the classified realm, but what is openly known is that anything that emits energy can be targeted, as stated before, with a weapon like the AGM-88. Secondly, the power emitted is relatively lower than with a more robust system like the ALQ-99, so overcoming the "noise" level of more robust

systems will require a more substantial power output. The third problem, although to a lesser degree, is that the jamming pod adds weight to the aircraft and takes away from its combat capabilities by utilizing a station where a bomb or missile could have been placed. In the scope of the *National Military Strategy (NMS),* the Joint Force needs to be more agile, cheaper, survivable, and lethal. Therefore the Marine Corps should be no different when looking for other solutions, and one such solution is in manned and unmanned teaming.

The Air Force, because of its mission of primarily conducting DAS, counter-air (CA), and strategic lift, is more focused on increasing the survivability to their currently manned aircraft. The Air Force is looking to implement the concept of an unmanned combat air vehicle (UCAV). The intent of this concept is to have a manned aircraft, controlling the unmanned vehicle to accomplish the mission in place of their manned counterparts.[9] The UCAV concept would look something like an unmanned F-35, but currently, the F-35s role is mainly as a command and control platform, not just a deep strike asset because of its limited payload. Presently, to maintain its stealth capability, the F-35 is capable of carrying two 1,000 pound air-to-ground bombs, which is a 50 percent reduction from the F-18 and AV-8B aircraft currently in use.[10] The takeaway here is for deliberate targets the F-35 is adept in this capacity, but in a CAS environment, this ordnance loadout may be insufficient. While technology is still in development, the goal would be to have an unmanned fighter that is capable of conducting air to air refueling, finding targets, and destroying them with the weapons payload onboard.

An additional benefit to utilizing a UCAV is that it does not host a pilot which requires rest and food, and are subject to chemical, biological, and radiological effects while a UCAV is not.[11] In the Air Force, the mindset of a UCAV is having an aircraft similar to a fighter jet that is quick, small, and capable of employing precision-guided munitions (PGMs). While the US Air

Force's focus in implementing MUM-T is specific to their needs, it arguably does not directly aid the Joint Force in waging air-land battle in a complex IADS environment. If the Air Force is to focus on being more supportive of the Joint Force, then making these UCAVs capable of jamming, would then benefit in conducting the mission for the Joint Force Commander (JFC). The Air Force is experimenting with placing jamming pods on unmanned aircraft that will be discussed later.

The United States Army is also in the process of testing MUM-T with the program called "Gray Eagle." The Gray Eagle is an MQ-1C UAV that is capable of employing PGMs. The Army has tested the AH-64 Apache in control of the MQ-1C to enhance the mission of its helicopters. The cost of an MQ-1C is roughly 21 million dollars, which is cheaper than a modern helicopter.[12] Also, the MQ-1C is significantly less expensive than the F-35 and F-22. The Gray Eagle has yet to be fitted with a radar jammer, but given its size, it has the capability to carry one. The Army's concept thus far is the closest thing to conventional MUM-T and has demonstrated great promise, but like the Air Force, the Army has yet to test SEAD with a UAV.

One key concern with the Army's concept is the manned aircraft pilot workload. This brings the conversation to who should control the unmanned platform. There are pros and cons with each method, but for the Army's purposes, an attempt was made to have the pilot control the UAS. The drawbacks became evident due to pilots only having so much mental capacity to process information pertaining to their aircraft, and manipulating another aircraft in the manner that is currently required is arguably a bad idea. However, if UAS platforms with the assistance of AI could understand voice commands, like a smartphone today, they would likely prove to be a force multiplier. The technology is not supportive of this concept yet but should be a focus for UAS in the future. Also, the traditional method of control a UAS is susceptible to jamming and

spoofing. This method has its benefits today, but in a near-peer environment, this method loses its usefulness.

Air operations contribute a large part to attriting assets on the High Payoff Targets (HPTs) list. Modern militaries today use air power to attrite targets far by conducting Deep Air Support (DAS) and by supporting the ground combat element (GCE) through Close Air Support (CAS). A RAND paper titled "Air Interdiction: Lessons From Past Campaigns," by Edmund Dews and Felix Kozaczka, eloquently surmised that ground offensives that the enemy deploys to conduct offensive operations create the conditions favorable for interdiction attacks.[13] While this is true, the assumption here is the air force benefiting from establishing and maintaining air superiority. When enemy air defense systems are introduced to conducting air operations, RAND research showed that an air force would have to increase the number of sorties generated to achieve success.[14] Looking back at the Yom Kippur War, the effects of SAMs becomes more grave when assessing the sorties capable of being produced. Given the increase in airpower required on today's battlefields to achieve high-quality results, the United States will need to develop more flexible, cheap, and lethal systems like the *NMS* describes to conduct air operations utilizing SEAD. The number of sorties required furthers the argument that MUM-T can assist in increasing the number of sorties generated. What MUM-T would allow is an increase in the number of sorties without a large increase to cost per flight hour, and the need to train and pay more pilots to fly. The number of sorties necessary to be generated is difficult to quantify. However, when the discussion is raised on suppressing IADS, it becomes essential to understand how this would be done, and that would be through the implementation of SEAD, which was discussed earlier.

To give an example of how SEAD enhances employable airpower, the United States adeptly conducted SEAD during the Persian Gulf War against Iraq. The US demonstrated that the air forces can help win the war while maintaining very low levels of aircraft losses.[15] Utilizing DAS, the US Air Force attrited a significant amount of the IADS so other DAS and CAS aircraft would benefit from air superiority, which directly contributed to the GCE's success in achieving combined arms, leaving the Iraqi forces decimated. The Persian Gulf War proved to be a milestone in achieving air-land battle and improved Joint Force operations. The takeaway is that the aviation force had dissimilar aircraft that had complementary results as opposed to one aircraft attempting to do all of the various mission sets at once. The military brought all of its airpower together and proved to be no match for the Iraqi air force or their ground force.

Given the tenacity of the new Commandant and his *CPG*, the Marine Corps and the HMLA are in a position to advocate for change in a way that has not been seen in nearly twenty years. If the Marine Corps is going to be focused on conducting EABO and if the HMLA desires to be relevant and survive against IADS in the Pacific, then there needs to be a change in the force. The Marine Corps is newly focused on conducting Expeditionary Advanced Basing Operations (EABO). The EABO scenario focuses on a Pacific near-peer enemy as an adversary and seeks to enable forward reinforcement of allies in the event of hostilities. The Marine Corps Warfighting Lab (MCWL) has been presented with a daunting challenge in accomplishing this mission because a near-peer enemy will likely have heavily invested in their anti-air and sea defense systems. The Marine Corps is looking to leverage the Joint Force in accordance with the *NMS* and *CPG* to conduct EABO.[16] One key concern is the validity of the Marine Corps conducting EABO without assistance from the Joint Force.

Additionally, the Marine Corps does not have as many air assets as the Air Force or Navy, which has shed light on adapting current platforms or acquiring new ones. Currently, the Marine Corps has yet to test MUM-T to the same degree as the Air Force or Army. Also, the Marine Corps has been slow to evolve in combating IADS because of the last twenty years of fighting in the Middle East. If the Marine Corps is to remain relevant to the Joint Force, significant strides must be taken to keep pace with advancing threats. Given the Marine Corps' limited budget, MUM-T can provide a cost-effective capability in supporting the Joint Force and conducting EABO.

METHODOLOGY & CASE STUDY

The paper utilized a qualitative methodology by examining existing research and providing a historical case study. This paper is also influenced by a wargame that was hosted by the Marine Corps Warfighting Lab (MCWL). While the results from the wargame are classified, there are lessons that can be gleaned that make them applicable to this paper. Through this process, it is clear that the military will need to make a more concerted effort in countering and defeating IADS. The case study used was the Yom Kippur War because it demonstrated how airpower could be crippled from SAMs due to their ability to be mobile, lethal, and inexpensive. The significance of this war shows that no matter how excellent a platform can be, the enemy will seek to counter that capability, and often the path taken is one that is cheaper and just as lethal.

In the Yom Kippur War between Israel and the Arab nations, primarily Egypt and Syria, the lethality of these systems comes to the forefront of the conversation. The critical weapon utilized by the Arab countries was the SA-6 or by its North Atlantic Treaty Organization (NATO) name, the “Gainful.” The SA-6 is a medium ranged, first-generation radar system with

a missile range of approximately seven nautical miles and a radar range of 13 nautical miles, and depending on the missile variant, the average maximum altitude is around 25 thousand feet.[17] Aircraft targeting systems were not prevalent during this time, which required pilots to visually identify their targets, especially given that precision-guided munitions (PGMs) such as joint direct attack munitions (JDAM) were not yet developed. The Israeli Air Force also was not familiar with conducting flight operations with the SA-6 present on the battlefield, which became apparent with the number of aircraft losses. The tactics employed resulted in the Israeli Air Force pilots flying within the weapons engagement zone (WEZ) of the SA-6, which had severe consequences for them.

The Israeli General, General Peled, during the Yom Kippur War, discussed with United States Secretary Henry Kissinger the problems Israel was having in the war. In their discussion, they conversed explicitly about the SA-6 and how it had a significant impact on their air operations. General Peled stated in their conversation that the Israeli Air Force had lost 32 F-4s, 53 A-4s, 11 Mirages, and six Super Mysteres for a total of 102 aircraft.[18] Imagining these losses of aircraft today would be devastating due to the increased complexity of modern aircraft and the time and resources that are required to produce them. Additionally, the Israeli Air Force had flown 11,000 strike and interception sorties reported on September 1st, 1978.[19] The number of sorties needed demonstrated that conducting operations in a contested environment is not only challenging, but the number of sorties goes up as the environment becomes less permissive. In a non-permissive environment, sorties are increased due to the likelihood of mission success going down. The cause of this lower mission success rate is due to the platform being deterred or interfered with in conducting its mission. The result is mission failure or a marginal success that may require another aircraft to complete the task. The lethality of this first-generation radar

system underscores the need for combating more advanced systems that are now into being fourth-generation systems. This volume of sorties generated by Israel will show to be significant later when discussing the Joint Force conducting airpower with MUM-T. The high number of downed aircraft would be seen as completely unacceptable for the United States in the present day, given the cost to produce and the limited number of them.

The second problem for Israel was the availability of pilots after a large number of them were killed or missing. General Peled, on the aircrew problem, stated that despite receiving new F-4s from the United States, the biggest issue was the number of aircrews left to operate them. The Israeli General went on to say that he had 69-70 crews left to operate the remaining 80-100 Phantoms.[20] While this seems trivial, air forces always have a portion of their aircraft under maintenance, and a set number of pilots cannot maintain flight operations indefinitely.

A crucial facet to consider regarding pilots is that they take a significant amount of time to train for combat, and losing so many pilots so quickly to the SA-6 directly impacted the Israeli Air Force ability to conduct air operations. In today's military, this rapid attrition of pilots and aircraft would have catastrophic impacts on the United States' ability to implement airpower due to the immense cost of airplanes and required training time for new aircrews. Replacing aircrews expediently is becoming more difficult given the growing complexity of the aircraft being operated in today's military. By moving to artificial intelligence capable unmanned platforms, meaning they can understand voice commands and are capable of making in-flight decisions on their own, this removes the pilot physically from the unmanned aircraft leaving only the need to manufacture and produce more aircraft. Making unmanned platforms tie in with their manned counterparts will afford increased sortie generation, and complementing characteristics of dissimilar aircraft.

HYPOTHESIS

One method of combating IADS would be to use MUM-T with jamming pods on the unmanned aircraft, which would provide numerous benefits. First would be allowing more manned aircraft to maneuver without as much risk given the limited EW capabilities today. Secondly, manned aircraft would be able to accomplish their mission without as much interference from radar assets. The meaning here is the manned aircraft would not necessarily need to adjust their route to circumnavigate or maintain standoff from a threat. Lastly, unmanned jamming aircraft could be integrated into the larger EW non-kinetic fires plan, which would holistically increase survivability for the force while complicating the enemy's targeting solutions. With the development of AI, if unmanned aircraft could be controlled by voice, this would prove to be a huge benefit because the traditional link between the control station and the asset would be less vulnerable. The second benefit would be that the pilot workload would not increase any more than having a traditional wingman. The data on this capability is currently nonexistent. However, the purpose of bringing voice-controlled platforms is to act as a springboard for others to look into and develop. By coupling unmanned aircraft with HMLA helicopters, this would increase the sorties produced and make the force more survivable and lethal. The teaming of unmanned assets with HMLA helicopters would increase survivability for the force because the overall force is distributed and dissimilar. This compounds the enemy's targeting in prioritization and execution. Secondly, the ground force is better protected by a more responsive aviation unit by placing attack helicopters closer to the expeditionary sites, which provides a more holistic defense. Lastly, the survivability is increased for manned aviation because the helicopters will be able to launch and conduct their mission without interference from radar-guided missiles. The lethality, therefore, becomes a byproduct of the

survivability. Weapons used by helicopters are dissimilar from their fixed-wing counterparts. The benefit of this is a way to reduce the amount of ordnance expenditure of the same type. There is a concern that by being more distributed and having dissimilar weapons that the logistics are more intensive. This is true, but when compared to the benefits that have already been stated, the benefits outweigh the costs.

WARGAME CASE STUDY

In January of 2020, a group of students with the Gray Scholars Program partnered with the Marine Corps Warfighting Lab (MCWL) to test EABO. The results are on the "secret" side, but what can be disclosed is that sorties required went up as was confirmed by the RAND study stated earlier.[21] The Marine Corps is betting on the fifth-generation F-35 fighter to be its Swiss army knife, and arguably it can do just that. However, there are a few problems that were discovered with the F-35 that needed to be supplemented. This is not to say that the F-35 is an inferior platform; it is quite the contrary. The argument is that the Marine Corps has hedged its bet on one aircraft to do more than is physically possible by its nature and surpasses what could be withstood by the human body. First, the F-35 is a multi-role fighter, generally speaking, it can do many things well, but no one thing exceptionally well. For example, the F-22 is a superiority fighter meaning it is designed to own the skies from airborne adversaries. These different designed platforms, in many ways, complement each other in mission and talent. If the Joint Force is to have a universal airplane to fulfill the tasked requirements, the F-35 is likely to be tasked to its limits when conducting EABO.

The second issue with the F-35 is the amount of internal ordnance it can carry. If the F-35 is going to maintain its generation five stealth capability, the amount of ordnance it can bring to the fight is restricted. The limitation results in a reduced number of targets that can be directly

serviced by the F-35. Due to the increased amount of sorties required, the HMLA, accompanied by MUM-T, can aid in fulfilling those requirements. In a contested environment, being stealthy is advantageous, but if an adversary can mass fighters, there comes the point where one may wish they had more missiles and were not merely focused on remaining unseen. The fact that the Marine Corps will no longer have generation four aircraft is going to place a higher burden on the F-35 unless the Marine Corps more holistically employs the aviation component to assist in this endeavor. This means that the Marine Corps will need to look for solutions, not just externally but also internally. Some targets are likely not worth the attention from the F-35 but are essential to ensuring sea denial is accomplished.

During the war game, the students were allowed to insert a flight of four AH-1Z Marine Corps attack helicopters. Each helicopter was armed with two AIM-9 "sidewinders" (heat-seeking missiles) and 16 AGM-114 HELLFIRE (laser-guided) missiles. The fast attack craft (FAC), and smaller class ships are a target that attack helicopters are well suited to destroy. The benefit of bringing attack helicopters into the fight is threefold. The first is that while attack helicopters are not as good in delivering information across the battlespace, compared to the F-35, they are still capable of increasing the number of sorties generated and providing other information in areas the enemy may not suspect. The second benefit of utilizing attack helicopters is, if the surface to air threat is mitigated, then lower priority targets can be serviced and afforded, which will reserve the weapons of the F-35 for other targets. The third benefit is that the forward arming and refueling points (FARPs) generally are dissimilar from fixed-wing FARPs. This results in a force that is more dispersed throughout the battlespace. The belief is that being more dispersed and having more targets for the enemy to choose from is that the survivability of the force increases since the enemy also has a finite amount of munitions. This

will cause the enemy to have difficulty in selecting which targets are appropriate, especially if the friendly locations appear to move "randomly" and without notice or use decoys. The pseudorandom movement will force the enemy to do a more in-depth analysis in the targeting process and more advanced technical means that provides information in a more timely fashion.

HMLA, EABO, AND OTHER MISSIONS

The HMLA brings several benefits to conducting EABO, aside from dissimilar dispersed FARPs and munitions delivery. One of those differences being the UH-1Y platform, which has the capacity to act as a tactical air coordinator airborne (TAC(A)), casualty evacuation (CASEVAC), and assault support provider. Additionally, both platforms in the HMLA have the capability to perform the role of forward air controller airborne (FAC(A)) as well, which in a CAS environment can prove to be a critical capability. Both mission sets afford a more robust communication network and extend the range of communications across the battlespace. The Marine Corps has struggled with maintaining the number of joint terminal attack controllers (JTACs) and forward air controllers (FACs), and this low number will need to be augmented by the air component. EABO sites will need professionally trained and skilled Marines, not just to coordinate fires but to manage the larger battlespace concerning the air and surface domains. This shortfall can be supplemented with the HMLA and can provide a quarterbacking function by providing organic precision fires (OPF). The HMLA has the largest number of trained FAC(A)s per squadron in the Marine Corps. The AH-1Z and UH-1Y training and readiness (T&R) manual states that a squadron is to have nine qualified FAC(A) crews, which is a core mission skill for the HMLA.[22] For the F-35, the requirement is three, and it is a core plus skill.[23] The difference between a core skill and core-plus skill is that the core-plus designation is not required for a unit to be combat deployable unless the unit has specifically been tasked with that

mission. This can lead to an F-35 squadron that has even fewer FAC(A)s than what the T&R recommends. The F-35 aircraft squadron size is currently open for discussion. The CMC has expressed that the number of aircraft per F-35 squadron may go down to ten. The F-35 T&R, in this case, states that only one crew is recommended to be qualified to do FAC(A). [24] The other pitfall of the F-35 doing FAC(A) is the fact that the aircraft only has one pilot while the HMLA aircraft have two. Having two pilots incurs added benefits because of the ability to task share and shed to someone else. With only one pilot attempting to do C2, fly the aircraft, monitor aircraft systems, is stressful, and approach the mental limits of human capability. The argument can be made that an F-35 will likely never fly on its own so task sharing can still be done with his/her wingman. However, the risk and responsibility fall solely on the pilot designated as the FAC(A), and having one pilot fly the aircraft while one pilot does C2 is extremely beneficial. The assault support communities, like the MV-22, do not train to this skill set. The benefits of this C2 capability do not have to be truncated to just coordinating fires. The HMLA can provide control of unmanned aviation platforms and even unmanned surface ships like the long-range unmanned surface vessel (LRUSV). When focusing on EABO operations, the ability to communicate becomes compounded rapidly when faced with the capability to jam communications. The other problem is the tyranny of distance given the vastness of the Pacific theater. The HMLA could also serve to act as a medium in communications from command centers to forward forces. This ability to perform as a medium serves to overpower enemy communication jamming equipment, and also to assist in radio relay even when communication jammers are absent. This capability already exists within the HMLA and should be capitalized on going forward.

As discussed earlier, the ability to generate sorties in a contested environment becomes more critical as the threat increases, and maintaining high levels of readiness will prove to be essential. The Marine Corps has been under scrutiny over the past several years due to mishaps and various other maintenance problems that have plagued the organization.[25] The F-35, too, has not been able to elude these problems.[26] Arguably, any new aircraft has kinks to work out, which takes time. However, the ability for the F-35 to generate sorties will come under heavy scrutiny, given the host of problems it has had and will likely see going forward. The maintenance problems will cut into the sorties capable of being generated, which will also reduce pilots flying in the aircraft to gain and maintain proficiency. The HMLA, however, has historically maintained high levels of readiness when deployed throughout its history, and its pilots traditionally maintain the highest number of flight hours in comparison to other communities. What this equates to is, on average, the HMLA squadrons are better trained and prepared to perform their mission sets than other aviation communities. When analyzing the Aviation Maintenance Supply Readiness Report (AMSRR) of an anonymously deployed HMLA squadron, the average numbers of readiness at any given time is around 70% mission capable.[2] An H-1 MEU detachment is usually seven aircraft, so this equates to 4.9 aircraft being mission capable. This means that an HMLA detachment, while deployed, can almost always source a division (four) worth of aircraft, and typically at least two pilots are always FAC(A) qualified and sometimes more.

Another overlooked topic of discussion is repelling an enemy amphibious force in an EABO environment. The expeditionary advanced bases (EABs) are likely vulnerable to a special operating forces (SOF) threat. The HMLA again stands to prove itself to be relevant to the Joint Force and the ground combat element (GCE). Throughout history, the HMLA has

[2] Identify of the squadron was withheld for operation security (OPSEC) concerns.

established itself to be a worthy community in providing CAS. With islands in the Pacific region being small in size geographically, the necessity for PGMs or unguided fires with precision type accuracy becomes paramount. The HMLA has weapon systems that are often dissimilar to its fixed-winged counterparts, which incur added benefits. The first being that the fixed-wing assets can utilize their finite amount of munitions for their appropriate mission sets, which are not further consumed from the rotary-wing. Arguably, the F-35 will likely have a limited role in the CAS environment due to the exquisite nature of its capabilities and being tasked for other mission sets such as enhancing situational awareness. One AH-1Z has the capacity to carry 16 HELLFIRE missiles, and one UH-1Y can carry 14 laser-guided rockets and several thousand rounds of bullets. The second benefit is that the HMLA ordnance can be employed closer to friendly forces than most other types of fixed-wing munitions, which reduce the likelihood of fratricide. Lastly, when looking at unguided munitions, the HMLA is adept in delivering close in fires when PGMs can not be employed due to global positioning system (GPS) jammers, spoofers, and laser interrupting technologies.

The Marine Corps' divestiture from tanks should lead the discussion to enemy tanks and which assets will remain available to attrite these forces. While the Army is very capable of engaging in a tank battle, the Marine Corps is attempting to release tanks from its inventory, and should another war occur, like the invasion of Iraq, the ability for the Marine Corps to mitigate this threat will be needed. This point transitions the discussion to what the Marine Corps will now be left with to deal with enemy tanks. The AH-1Z is designed to destroy tanks, and it does so very adeptly. Fixed-wing munitions, aside from the laser-guided Maverick missile, are not as capable at destroying tanks. Shaped charge type weapons are better suited in defeating armor, while high explosive bombs are less capable. Bombs like the GBU-12 (laser-guided 500-pound

bomb) may hit the target and register a mobility kill (m-kill), but will likely not render the tank completely destroyed. This fact is especially true for most modern tanks that have reactive armor. This target type also tends to be lower on their prioritized target list. Divestment of more HMLAs may prove to be a mistake if the ground forces face an enemy force with numerous tanks on the battlefield.

The HMLA has also proven itself skilled at crisis response from expeditionary means. From all the previous points made about offensive air support (OAS), C2, CASEVAC, and assault support, the HMLA will still have relevance and be needed not just for the Marine Corps, but the Joint Force as well. The number of operations and examples are numerous and go beyond the scope of this paper. However, the HMLA will still be needed when embarked on a ship. The utility can be placing HMLA detachments on LPD class ships, like what has been traditionally done in the past, and augmenting them with unmanned platforms. The function and design for this should be researched further to demonstrate the capabilities. From a Marine Expeditionary Unit (MEU) standpoint, the HMLA can help augment the sorties necessary that the F-35 may not be capable of supporting. Furthermore, in the continental United States (CONUS), there is a great need for HMLA support. Entities like tactical air control party (TACP) schools, infantry battalions, and SOF units reap numerous benefits from HMLA support. The JTAC/FAC programs are kept mainly alive because the HMLA provides the bulk of the CAS sorties needed for their training. Fixed-wing squadrons traditionally prioritize training sets by month, and if CAS is not in their purview, they generally do not support CAS events unless it lines up with their training plan. There are exceptions for fixed-wing squadrons supporting CAS outside of their training plan. The point being made here is since CAS is the bread and butter of the HMLA they are almost always willing to support.

The last cause for concern is the lack of a dedicated EW platform. The decommissioning of the EA-6B "Prowler" has created a capability gap for the Marine Corps that has not been fulfilled by another platform. This capability gap is alarming when faced with an adversary that is on par with United States forces. If the Marine Corps is to follow its motto and continue to be the "first to fight," when facing modern adversaries, it is going to require the force to compete in the electromagnetic spectrum against radar threats. The assumption here is that the Marine Corps can conduct operations without the assistance of other aviation assets. Now that the Marine Corps is in the process of fielding the MQ-9B aircraft, the Marine Corps is attempting to correct this deficiency. Currently, the MQ-9B is planned to be equipped with the Intrepid Tiger 2 (IT2) jamming pod, which will be a step towards fulfilling the EW capability gap.[27] However, the MQ-9B will still be controlled in the traditional way. Another shortfall is that the MQ-9B, too, will not be numerous and be required to conduct mission sets that do not support MUM-T and HMLA operations. The point being emphasized here is that in order to make MUM-T effective, the unmanned platform needs to be more autonomous and is capable of being controlled by the manned platform. When discussing control of the unmanned platform, the intention here is that the pilot of the manned platform is controlling the unmanned one via voice and not by a tablet, as attempting to make manual commands would detract from their mission. Much like a cell phone can be given instructions to perform tasks, the UAS needs to have this capability as well. Furthermore, the traditional method with a control station manipulating the unmanned platform is vulnerable due to the link that is required when considering a peer or near-peer threat that can compromise the network, which is arguably not preferred.

Placing jamming pods on unmanned platforms provides several added benefits. The first being anything that emits a signal can be targeted unless robust measures are taken to disguise

the signal. While the MQ-9B is not necessarily cheap, it is in comparison to the F-35. This means that the United States will be able to tolerate these losses more easily from a strategic point of view, as was recently the case with Iran shooting down a US drone.[28] The second benefit is that the production of MQ-9B can be faster than that of the F-35 because stealth aircraft are more difficult to manufacture. The Air Force is currently in the process of developing just such a capability. The specific details are on the "secret" side and likely several years away from seeing the operational forces. With the Air Force in the process of potentially developing this capability, however, the Marine Corps stands to benefit because it would allow the Marine Corps to save money in the research and development process, and buy the capability outright alongside the Air Force.

Based upon what is known thus far on IADS and MUM-T, this transitions the discussion to how MUM-T can be employed in the Joint Fight to enhance combined arms. When going against IADS, there are three phases that encompass entering the WEZ, conducting air operations, and safely egressing once complete. The first step of gaining entry into the operational environment is for the aircraft to remain unseen from the beginning. This can mean flying into the WEZ, or already being inside of it. The second part will be the focus of this discussion because the concept of EABO plays mostly into this point. There are a couple of ways this can be achieved when looking at MUM-T as a solution. For purposes of this discussion, the focus will be on a platform like the MQ-9B with a jamming pod. Due to the low cost of producing an unmanned aircraft, more could be built and flown in unison to saturate the radar picture for the enemy. This high volume of unmanned aircraft would create high levels of radar returns, allowing friendly forces to have the advantage and be able to "hide" in plain sight of the enemy. This could be several UAS aircraft or even hundreds.

If the unmanned aircraft are carrying radar jammers, this further complicates the enemy to be able to "see" the environment that is assigned to them. By obscuring the radar picture, this frees up manned aircraft to maneuver into the battlespace to conduct their mission. By having several jammers, this can be analogous to a reverse integrated radar system that has assets further away saturating the environment. Meanwhile, other UAS close in are doing the same, which in effect complement each other.

Once inside the WEZ, manned aircraft will need constant radar jamming coverage in order not to be attrited by a radar-guided SAM. Looking at the current pacing threat with China, the United States forces will benefit from having a substantial unmanned force providing that constant coverage to ensure the survivability of its aircraft. Radar jamming aircraft are low in quantity meaning the Joint Force Air Component Commander (JFACC) will likely be judicious in employing these assets. In a joint fight, it would be inaccurate to assume that these EW assets would be readily available to support a large number of sorties. This point also includes the F-35 given its capabilities to support the Joint Force.

As previously stated, a large portion of the conversation has focused on unmanned assets conducting aerial interdiction. The current use of unmanned assets does not go far enough. UAS could also compliment other assets when conducting assault support operations or EW operations. Aircraft like the CH-53 and MV-22 would also benefit from MUM-T because the rotor blades are unable to reduce their radar cross-section (RCS), making them easily identifiable targets for radar-guided systems. By having an unmanned asset with a radar jammer, this would allow both strike platforms, and assault support platforms to operate with limited interference. The assault support platforms like the CH-53 and MV-22 would afford the GCE to maneuver about the battlespace more freely and quickly without as much risk to the very platforms

attempting to move these ground elements. The HMLA can assist in this role by controlling the unmanned platforms and providing the C2 function necessary for these unmanned and manned assets because of the inherent ability of C2 proficiency, as stated earlier. The Pacific region is vast, and weather patterns are dynamic when assessing sea state and precipitation. Utilizing surface assets can be arguably more dangerous, especially when these ships get smaller and can be more easily capsized by waves. Having the ability to move personnel and equipment via air will be a critical capability, and the air movement will likely require some expertise to mitigate their detection.

The HMLA has proven to be a force multiplier throughout history because these assault support platforms can be vulnerable to being interdicted by surface and aviation threats. The HMLA has a mission essential task (MET) of providing escort to aviation and ground assets. By having HMLA aircraft escort these assault support platforms, the burden would be lessened for the fixed-wing assets conducting other operations to which they are more suited to carry out. If the Marine Corps is going all-in with the F-35, then tasking the F-35 to conduct escort operations is likely a misappropriated use of assets. If this proves to be accurate, then the HMLA will be needed to exercise this mission set and will need the assistance of unmanned platforms to provide radar jamming to mask the very movements of these aircraft.

The glaring limitations for the HMLA are the speed and range at which they can fly in comparison to platforms like the MV-22. The range for H-1 helicopters can be increased with auxiliary fuel tanks, although this would sacrifice the amount of ordnance they are capable of carrying, for example, PGMs. However, this compromise would still be beneficial despite the reduction in ordnance because of the increased sorties provided, as stated earlier, more PGMs present on the battlefield, and the C2 capability that the HMLA brings. The key to minimizing

the impact on H-1 limited range is through effective planning and coordination. The wargame discussed earlier demonstrated that precise placement of these helicopters can prove to be beneficial when the need for more ordnance, escorts, or C2 is required. Proper placement of H-1 detachments with EAB sites can be a force multiplier when paired together. As mentioned before, the HMLA trains to doing TAC(A) and FAC(A), which is a mission set that is very difficult, if not impossible, for an unmanned asset to do. The basic concepts of providing escort and clearing a landing zone by fire are functions that a UAS would also struggle with while the HMLA is better suited to these tasks.

To address the limited range aspect of the AH-1Z further, it is important to inform decision-makers and planners on its capabilities correctly. The program used for the calculations was the Air Vehicle Performance (AVP) program that is the standard program for AH-1Z weight and power planning and a CR-2 computer. The planning assumptions made for this paper assumed a speed of 141 knots, which is the optimal maximum range airspeed at a pressure altitude of 200 feet, which is an altitude in the envelope that the AH-1Z would likely fly, and a temperature of 25 degrees Celsius. The other variable assumed is no head or tailwind component on the aircraft. The variables of atmospherics are too many to capture in this paper. The numbers generated first assume with no auxiliary fuel tanks and then with auxiliary fuel tanks. The aircraft is simulated to be loaded with 16 HELLFIRE and a full loadout of 20mm rounds. With these metrics in mind, the AH-1Z has the capacity to travel a distance of 305 nautical miles with a time aloft of two hours and ten minutes as a straight line distance. If a 30 minute time on station (TOS) or loiter time is desired, to perform a mission like CAS, the combat radius comes to 127 nautical miles. Combat radius assumes that the aircraft will depart, conduct their mission, and return to the point of origin. While obvious to some but important to note for others is that

TOS and combat radius are inversely proportional. The second simulation was fitting an AH-1Z with two auxiliary fuel tanks and removing eight HELLFIRE missiles to make room for the additional fuel tanks. All other inputs were unchanged for this simulation. The results were increases to a range of 430 nautical miles and a three hour and three minute time aloft. The combat radius increased to 187 nautical miles, again assuming a 30 minute TOS. What the takeaway here is, a three hour time aloft is amicable for an attack helicopter, and during that time, the aircraft can be doing a multitude of functions. The 430 nautical mile range is worth noting, too, because of the ability to depart and land at FARPs or other airfields over longer distances. Arguably, the HMLA has more utility in a dispersed environment than people may assume it to have.

The need for multiple unmanned platforms capable of conducting radar jamming cannot be understated. This multitude of unmanned assets would aid in saturating the radar picture and permit the force to maneuver with less interference. For air operations to be successful more sorties will need to be generated. As discussed earlier, with the Yom Kippur War, if the Israeli Air Force was required to conduct over 11,000 sorties in 1978, it is clear that more sorties will be expected to support the Joint Force in the future. Due to the increased sortie requirement, this means that given the limited number of F-35 and EA-18 assets, coupled with a large number of sorties to be generated, the Joint Force will need cost-effective systems capable of conducting the EW mission. The last point is the weapons payload that is required in a target-rich environment. The F-35, if it desires to remain stealth, has a very limited payload. There comes the point where having more missiles or bombs is more critical than the exquisite capability of a given platform like the F-35. The MCWL wargame, in many aspects, demonstrated this point, and the Marine Corps would be wise to consider it.

CONCLUSION

In summary, countries like China and Russia have not stopped in their development with SAMs because of the perceived threat of US airpower. These weapon systems have become so advanced that current countermeasures, such as chaff on aircraft, are severely limited, which has driven the United States to look to stealth technology. However, stealth technology is so expensive that making all aircraft stealthy is impossible based on current technological and fiscal constraints. The Yom Kippur War demonstrated the consequences SAMs can have on a nation attempting to employ airpower, which impacted the Israeli capability to achieve combined arms. The current methodologies for conducting SEAD lays the foundation in defeating IADS to achieve air superiority. Still, given new technology, the Joint Force will need to adapt and enhance these capabilities. Joint Force current testing for MUM-T has primarily focused on achieving airstrikes through aerial interdiction with little regard to the radar threat. Given the capabilities of countries like China, the current capabilities of unmanned vehicles do not go far enough in what they are capable of doing. Unmanned platforms can mitigate radar threats and increase survivability to manned aviation platforms. If the Marine Corps is to operate in an EABO environment, it will need the complementary aviation force to succeed. The HMLA has proven to be a critical resource in supporting the ground forces with close air support fires, deep air support, and escort operations affording assault support platforms to move about with more protection. Lastly, MUM-T could be an augmenting capability when conducting air operations. Given the lower cost, reduced complexity, and greater flexibility, MUM-T would help the Joint Force in achieving its goals in the spirit of the *NMS.* Furthermore, MUM-T would demonstrate that the concept of air-land battle is still relevant to achieving combined arms because of the increased survivability and lethality.

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