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14. ABSTRACT
The Marine Corps is not optimized to meet the needs of the 2018 National Defense Strategy. In addition to blunt layer deterrence, the service needs combat credible forces to fight in competition, in the contact layer. At present, Marine Corps aviation platforms do not adequately provide complete capabilities to fully enable Marines in this layer. Specifically, the service lacks the awareness and lethality delivered through persistent Remotely Piloted Aircraft (RPA) ubiquitous on many urban battlefields common throughout the last decade or more. As a solution, the MQ-9B SeaGuardian is an available option providing long-range, all-weather, Intelligence Surveillance and Reconnaissance (ISR) for the future force as it contends advisories in the contact layer.

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EXECUTIVE SUMMARY

Title: MQ-9B in the Contact Layer

Author: Major Christopher D. Luger, United States Marine Corps

Thesis: To win in the contact layer, Marines will need a persistent, medium altitude long-endurance (MALE), reliable, multi-role unmanned aircraft, capable of detecting and identifying targets at the operational and tactical level while simultaneously providing shared battlespace awareness and communications throughout the contact layer; this capability is available with the MQ-9B.

Discussion: As highlighted by the 38th Commandant of the Marine Corps, General David H. Berger, the Marine Corps is not presently organized to meet the threats and challenges that lie ahead for the United States. These challenges, outlined in the *2018 National Defense Strategy* with service specific guidance outlined in General Berger's *38th Commandant's Planning Guidance*, identify the increasing emphasis on deterrence through competition and actions in the contact layer. Since many of the aviation resourcing decisions are based upon competition and winning in the blunt layer, the current force structure and aviation capabilities are not presently optimized for operations in the contact layer. This presents a challenge for the Marine Corps as it considers how to reorganize and provide lethality to Marines who can serve as the necessary deterrent the National Defense Strategy calls for. Specifically, the service lacks the awareness and lethality delivered through persistent Remotely Piloted Aircraft (RPA) ubiquitous on many urban battlefields common throughout the last decade or more. As a solution, the MQ-9B SeaGuardian is an available option providing long-range, all-weather, Intelligence Surveillance and Reconnaissance (ISR) for the future force as it contends adversaries in the contact layer.

Conclusion: The MQ-9B airframe is the solution the Marine Corps needs to enable success in the contact layer. The arguments against its utility within the Marine Corps are informed, however, when kept in perspective to its optimal utilization the aircraft is exactly what the Marine Corps needs to enable future forces. The airframe is robust, all-weather, long-range, and most of all reliable to meet the needs of the future force while maintaining flexibility for future development in other warfighting domains.

Preface

Throughout my deployments in Iraq and Afghanistan, I saw the incredible capability that unmanned aircraft provided to the Marine on the ground. Simply put, I was amazed that a Marine could physically talk to a Remotely Piloted Aircraft (RPA) pilot, who in some cases was geographically in another hemisphere, with the handheld radio. Today the RPA enterprise is an incredible instrument of military power and foreign policy. It has given the United States Military the capability to take decisive action against terrorists, state officials, and Violent Extremist Organizations (VEOs) with surgical precision and minimal political risk while providing unprecedented quantities of information to complete decision-making cycles. There is no denying that RPAs have changed the way war is conducted.

Unfortunately, the Marine Corps is behind in RPA capabilities. Today the only Marine Corps Program of Record (POR) for an unmanned aircraft remains the RQ-21. Underfunded, and a decade behind in technological utility, the aircraft and system are plagued with mishaps calling into question its reliability for future service and joint missions. Though even solving reliability doesn't address its tactical and operational uselessness. Fixed to a local terrestrial site with a heavy footprint and high electromagnetic signature, the RQ-21 is only capable out to 50nm, hardly the extended ranges necessary for the future operating environment. Though, despite its marginal utility, the Marine Corps is still heavily invested in RQ-21 with no plans to divest of the troubled platform.

Unmanned aircraft offer an advantage that traditional manned aircraft cannot, persistence. Without a human, the aircraft is not limited in time, duration, or operational risk. Therefore, it offers military commanders' incredible persistent capabilities with an unprecedented low operational and strategic risk. It is time for the Marine Corps to embrace unmanned technology

and fully invest in a platform with that can range the distances where Marines will fight in the future.

Introduction

In 2001, General Atomics, in conjunction with the United States Air Force (USAF), conducted the first successful test shot with an inert AGM-114 Hellfire missile off an unmanned aircraft. The RQ-1 aircraft, at the time, was not new to military service, it had seen combat during conflicts in the Balkans and even suffered losses in the conflict. However, the successful test on 16 February, 2001¹ in many ways changed warfare much the same way the introduction of helicopters ushered in new concepts such as vertical envelopment. Since that successful test, the Department of Defense has invested heavily in unmanned technology. Today, surgical air strikes from unmanned aircraft are executed routinely. The information they collect is funneled into a massive Distributed Common Ground System (DCGS) where over 1,000 hours of Full Motion Video (FMV) are collected daily.² Numerous declared enemies of the United States have met their demise from a Remotely Piloted Aircraft (RPA) patiently waiting above. Among all of the numerous examples, the return on unmanned investment has reshaped foreign policy and political strategy across multiple election cycles and cemented itself in the United States Military.

Unfortunately, the Marine Corps has been slow to adopt the capabilities of persistent and lethal Medium Altitude Long Endurance (MALE) unmanned aircraft. Marked by early success with the RQ-2 Pioneer in the Gulf War, the Marine Corps has stalled with its technological advancements in unmanned aviation. The RQ-7 Shadow, and now RQ-21 Blackjack are nothing more than marginally improved platforms from the RQ-2. Optic resolution has improved, however, additional capability improvements along with airframe reliability are not

¹ Richard Whittle, *Predator* (175 Fifth Avenue, New York, N.Y. 10010: Henry Holt and Co., 2014). 261.

² Max C. Johnson, *Operational Reconnaissance for the Anti-Access /Area Denial Environment*, Defense Technical Information Center, (2015).

commensurate with the technological advancements over the last 30 years.³ Both platforms do not compare to the MQ-1C Gray Eagle and MQ-9A Reaper, Programs Of Record (POR) in the United States Army (USA) and United States Air Force (USAF) respectively. Configured with modern high-definition Electro Optical and Infrared (EO/IR) optics, Synthetic Aperture Radar (SAR), Moving Target Indicator (MTI), a variety of other ‘special’ sensors, precision lethality, and above all increased persistence through aircraft endurance, both the MQ-1C and MQ-9A personify the technological advancements of the 21st century which have changed modern warfare. Subsequently the lack of similar aircraft in favor of the less capable Shadow or Blackjack, represent a technological capability gap in the Marine Corps, which General David H. Berger, 38th Commandant of the Marine Corps, highlighted as a significant underinvestment in a recent letter to the service.⁴ This coupled with General Berger’s 2019 Planning Guidance, acknowledges this gap and directs a course correction in conjunction with service realignment towards great power competition with China in the Pacific.

The 2018 National Defense Strategy (NDS) formally addressed the many challenges we face today. In doing so it directed the services to reorient themselves on great power competition in order to achieve a credible deterrence against rising global powers.⁵ With each service extracting their own modernization tasks based on their respective warfare domains, the Marine Corps must recapitalize itself to serve as a combat credible deterrent force persistent in the contact layer. Presently, as indicated by both General Robert Neller, 37th Commandant of the

³ Noah M. Spataro, VMU-1 YEAR IN REVIEW OF WORLDWIDE UAS OPERATIONS, (2019).

⁴ David H. Berger, "Notes on Designing the Marine Corps of the Future," *War on the Rocks* (Dec 5., 2019). <https://warontherocks.com/2019/12/notes-on-designing-the-marine-corps-of-the-future/>.

⁵ The Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America* (Washington, DC, 2018) 7. <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

Marine Corps (CMC)⁶, and the current CMC, General Berger, the Marine Corps is not currently ready to accomplish these missions ergo it is not ready to win the next fight. While the wholesale recognition of this is widespread throughout the Marine Corps, the more underlying translation when aligned with the 2017 National Security Strategy (NSS) and 2018 NDS is the Marine Corps is not ready to deter the next fight.

As highlighted by many published academic sources, the decades-old Joint Forcible Entry Operations (JFEO) doctrine is untenable. Specifically, the United States presently does not have the capital required to successfully execute forceable entry.⁷ So as the Marine Corps recognizes that its JFEO namesake is no longer a credible deterrent, it simultaneously recognizes that it must invent a new credible deterrent within the contact layer. From this recognition many ideas have successfully depicted new stand-in forces and other operational concepts designed to place Marines within their adversaries growing engagement zones across enduring competition. However, with the vast distances of the Pacific theater, our current aviation POR aircraft are not optimized to support these Marines. To win in the contact layer, Marines will need a persistent, medium altitude long-endurance (MALE), reliable, multi-role unmanned aircraft, capable of detecting and identifying targets at the operational and tactical level while simultaneously providing shared battlespace awareness and communications throughout the contact layer; this capability is available with the MQ-9B.

The Importance of the Contact Layer

The Contact Layer is the first recognized conflict layer as described in the 2018 NDS. Described as activities “designed to help us compete more effectively below the level of armed

⁶ Chris Brose, WOTR Podcast; <https://podcasts.apple.com/us/podcast/war-on-the-rocks/id682478916?i=1000446391711>.

⁷ LtCol Scott Cuomo et al., "Not Yet Openly at War, but Still mostly at Peace, Exploit the Opportunity to Become the 21st Century Force that our Nation Needs," Feb, 2019.

conflict,”⁸ the contact layer is a critical part of our layered defense framework. It is within this layer where the United States actively works with its allies and partners to identify malign behavior, counter malicious activity, and secure American prosperity through the shared access to free markets and unmolested global trade. And while this sounds protectionist, it is mutually beneficial for our allies and partners in countering ever expanding global instability influenced by repressive governments like China and Russia. Since it is the layer below the threshold of armed conflict, its principal role is to deter hostilities and preserve peace by countering malicious activity. And as the other layers are equally important in overall strategic deterrence, the contact layer is the only layer whose success depends on indefinite persistent presence.⁹

Recent world events have highlighted the changing global environment and the need to alter the U.S. National Defense framework. The 2014 Russian annexation of Crimea and the territorial claims made by China in the South China Sea,¹⁰ are the chief examples of the emergence of competition in the last 10 years. Therefore the 2018 NDS formally recognized that the United States’ focus on terrorism since 9/11 had to transition towards strategic competition with China and Russia. Subsequently, the Department of Defense’s diligent efforts on reinvestment give the U.S. Military modern technology designed for a high-end peer fight. As part of a broader strategy, this strategic competition is purposed to reinforce the ‘M’ in the DIME (Diplomatic, Information, Military, Economic) national power model, where a strong and capable military is a vital pillar in enforcing the threat of an undesired outcome for our advisories. Without it, the other three pillars are weak to stand on their own without the ambient

⁸ NDS, 7.

⁹ Gordon Emmanuel and Justin Gray, "The Marine Corps’ Evolving Character and Enduring Purpose," May 06, 2019.

¹⁰ Brahma Chellaney, "Beijing's South China Sea Grab," *Japan Times*, Dec 18, 2018, <https://www.japantimes.co.jp/opinion/2018/12/18/commentary/world-commentary/beijings-south-china-sea-grab/#.XICRkC2ZNOK>.

threat of American power reinforcing the other three. Therefore, it is imperative the Marine Corps carefully evaluate its own purpose within the NDS and modernize itself to effectively contribute to the new end state.

One of the Marine Corps principal roles in the National Defense framework, is to serve as a contact layer force, constantly engaged with U.S. Allies working to identify and counter malign behavior.¹¹ This purpose, recently reemphasized by General Berger in his 2019 planning guidance, is clear: “Together, the Navy-Marine Corps Team will enable the joint force to partner, persist and operate forward despite adversary employment of long-range precision fires.”¹² This further aligns service priorities and directs senior leadership to begin the rigorous task of organizing the Marine Corps for contact layer operations. And while these operations, or the forces organized to operate within this layer, are not exclusively designed for high-end combat, they must still be organized and equipped for success. This means they require the equipment and capabilities to enable their success in both the contact and blunt with the expectation that success within the contact layer will withhold armed conflict in blunt. Further, as competition grows the historical likelihood of armed conflict between superpowers diminishes, yet the probability they will engage in proxy wars and low intensity armed conflicts elsewhere increases.

As illustrated by *War on the Rocks* Author, John Vrolyk, the intense focus on high-intensity conflict, while necessary, ignores the most likely course of action by our potential adversaries.¹³ With the competition environment today, our contests with China and Russia will likely not involve our Treaty Allies, but rather the moveable middle, the rest of the world whose

¹¹ Tim, *Not Yet Openly at War, but Still mostly at Peace: An Interview with LtCol Scott Cuomo (USMC), Not Yet Openly at War, but Still mostly at Peace: An Interview with LtCol Scott Cuomo (USMC)*. 2019.

¹² David H. Berger, *Commandants Planning Guidance*, 38th Commandant of the Marine Corps (Washington D.C.: Headquarters Marine Corps, 2019). 2.

¹³ John Vrolyk, "Insurgency, Not War, is China's most Likely Course of Action," *War on the Rocks*, Dec 19, 2019. <https://warontherocks.com/2019/12/insurgency-not-war-is-chinas-most-likely-course-of-action/>.

developing economies will be influenced by either the United States, China, or Russia. Examples of this include proxy wars in developing countries like the Philippines, or African nations, where insurgent forces are supported by China and Russia in an effort to undermine governments and undercut U.S. advantages.¹⁴ Look no further than Iran's support to Houthi Rebels in Yemen as an example of how two competitors, Iran and Saudi Arabia, actively try to undermine one another through contested spaces instead of direct conflict. Complicating this matter is the growing global competition for state 5G wireless technology, and the inherent advantages it provides to the winning provider.¹⁵ So as the competition space continues to escalate, the United States will likely be required to defend its partner nations or risk losing vital military and economic access in the future. Thus, to fight and win against proxy forces waging low intensity insurgencies in what many call the Gray Zone, the United States must dominate the information environment and fight a counterinsurgency whether it wants to or not. With this unfortunate reality, as the contact layer force, the Marine Corps must have the requisite capabilities required to win in the contact layer which will be a struggle without the persistence of MALE UAS.

The operational success of Group 5 Remotely Piloted Aircraft (RPA), specifically the MQ-1 Predator and MQ-9 Reaper, have been well documented throughout the last decade. In March of 2019, General Atomics Aeronautical, the manufacturer of both aircraft, reported crossing the 4-million-hour threshold as a program. For perspective, the United States Air Force U-2 program, dating back to the 1960's, has only documented around 485,000 flight hours.¹⁶

¹⁴ John Vrolyk, "Insurgency, Not War, is China's most Likely Course of Action," War on the Rocks (Dec 19, 2019). <https://warontherocks.com/2019/12/insurgency-not-war-is-chinas-most-likely-course-of-action/>.

¹⁵ Vrolyk, "Insurgency, Not War, is China's most Likely Course of Action,"

¹⁶ Allen Cone, "Air Force's Predator, Reaper Drones Pass 4 Million Flight Hours," United Press International (Mar 12, 2019). <https://www.upi.com/Defense-News/2019/03/12/Air-Forces-Predator-Reaper-drones-pass-4-million-flight-hours/2611552400152/>.

This 8:1 exponentially growing ratio is a telling indication of the growing demand unmanned aircraft have received throughout numerous operations during the Global War On Terror (GWOT). Favored by so many for its capabilities; communications, Electro Optical/Infra Red sensors, radar sensors, and other SIGINT possibilities, it is its low-risk persistence that makes it the tool of choice for military and political leaders alike. The ability to maintain surveillance of a wide variety of potential targets and concurrently employ lethal munitions in the same mission has made the General Atomics fleet of aircraft a critical capability throughout the GWOT. And while the aircraft concept was a product of the intelligence community,¹⁷ ground force commanders in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) began demanding the platform to enable maneuver at the operational and tactical level.¹⁸ Saving American lives through its persistence, battlefield awareness, and lethality, were revolutionary for modern warfare much the same way helicopters revolutionized warfare through vertical envelopment 50 years prior. The persistence in the end though, is the trait making unmanned aircraft so ubiquitous on the modern battlefield; this persistence provides a decisive advantage in information unmatched by any other aircraft.

As the recent war against the terror group Islamic State of Iraq and Syria (ISIS) has shown, the contest over the information space is critical. Its critical because proxy wars will likely be a competition of ideas and influence, not outright annihilation or capitulation through total dominance. Thus, whoever can control the narrative and maintain awareness of the environment is likely to succeed. This makes persistent aircraft systems with a wide variety of sensors, optimal for the coming contact layer. Further, the maintenance of the information environment through persistent interaction, both overt and covert, will achieve the deterrent

¹⁷ Whittle, 234.

¹⁸ Whittle, 234

effect required to win in the competition space and ultimately prevent escalation into the blunt layer. As Major John Zaimis writes in his Naval War College thesis: “[RPA] operational deterrence complements other instruments through its uncanny ability as a persistently present platform with a reduced risk to force.”¹⁹ So not only is the aircraft enabling success in the information environment, its relatively low-risk allows a wider envelope of employment which demonstrates to opponents U.S. flexibility, further increasing the deterrent effect. Consider this, what incentive would China have to continually disrupt unmanned flight operations if the economic cost curve favored the United States without imposing the political risk associated with a downed American pilot? There would be no incentive beyond disrupting the architecture, which is possible but challenging. Therefore, the increased investment on MALE RPA aircraft when preparing for competition in the contact layer is essential if the United States intends to win in contact and prevent escalation to blunt.

It’s about Logistics, “There’s no UPS Overnight for an Expeditionary Advanced Base”

In addition to many advantages of the MQ-9 and its operational success, one of its distinct advantages when compared to many manned counterparts is its relatively small forward presence. Traditional aviation squadrons require significant infrastructure to sustain themselves forward. Airfields, gas, pilots, maintenance personnel, maintenance equipment, spare parts, solvents, safety equipment, and then some, aviation sustainment can quickly become a massive footprint. Sustaining this footprint requires an intensive logistics train. Of course, the present challenge is the increasing threat of Anti-Access Area Denial (A2/AD) weapon systems which limit the buildup of these required bases. This burden can be relieved from the sea if not for the fact that ships have become prime targets themselves. Therefore, the Marine Corps’

¹⁹ John J. Zaimis, "RPAs in the Gray Zone: An Asymmetric Advantage for the Operational Commander" Naval War College, 2018), 28.

Expeditionary Advanced Base Operations (EABO) concept seeks to address these concerns by extending the range of F-35 Lightning II's through temporary Mobile Forward Arming and Refueling Points (M-FARPS).²⁰ These short duration M-FARPS, are purposely designed to limit massed exposure within advisory Weapon Engagement Zones (WEZ) through distributed operations. And while the concept itself has merit; it generally ignores the sustainment required to properly staff an M-FARP that provides any marginal utility.

As Robert C. Owen highlights in the *Naval War College Review*, a compliment of 28 F-35B's providing persistent sector coverage, landing twice at M-FARPS before returning to their home ship or station, would require "336 tons of fuel and up to 280 tons of containerized munitions each day."²¹ Even scaled down to one division's worth of F-35B, to hit the same M-FARP twice would require 96 tons of fuel forward staged. Subsequently, combatant commanders have limited options with F-35 within the WEZ: forward stage the 28 aircraft within the WEZ at the risk their destruction, or create standoff through a massive, vulnerable, and likely unsustainable logistics train. While neither solution is perfectly binary, neither is the comparison in capabilities between F-35 and MQ-9. Both aircraft were designed for two different missions and do not warrant comparison. They do, however, offer different capabilities more aptly suited for different environments which offer a variety of options to the Joint Force Commander, enhancing the distributed lethality of Marine maneuver units operating underneath the umbrella of the advisory WEZ.

Because massing capabilities like F-35 within the range of their weapon systems places them in a currently unsustainable logistical position, it makes competition within the contact

²⁰ . Expeditionary Advanced Base Operations (EABO) Handbook; Considerations for Force Development and Employment Marine Corps Warfighting Lab, (2018).

²¹ Robert C. Owen, "Addressing the Mismatch between Requirements and Capabilities," *Naval War College Review* 69, no. 4 (Oct 1, 2016), 30. <https://search.proquest.com/docview/1827605361>.

layer ever more vital. Competition in this space is likely to be more permissive and tolerant of reconnaissance and surveillance, especially from unmanned systems. Instead the proxy fights between peer competitors are more likely to constitute an electromagnetic spectrum game of move-countermove and cyber warfare. Thus, with the range and persistence, the MQ-9B is an acceptable solution to forward staging by creating a presence outside advisory striking distance yet within the aircrafts range.

MQ-9B SeaGuardian – The Aviation Solution to a Naval Expeditionary Force in Readiness

Recognizing the tremendous success of the MQ-1 Predator and MQ-9A Reaper, General Atomics Aeronautical (GA-ASI) invested its own capital to upgrade the existing MQ-9A Block 5 aircraft. This investment came at the recognition that despite the overwhelming success of the current fleet, its design was based around a solution to a strictly military problem. As success continued and the airframe became more and more reliable, applications beyond the bounds of war and armed conflict were realized. Yet current aircraft were not type certified for flight in Federal Aviation Administration (FAA) national airspace, their flight clearances kept them bound to U.S. Restricted airspace, or narrow FAA Certificate of Authorization (COA) corridors. Therefore, as U.S. agencies and State Air National Guard (ANG) units began to demand greater utility out of these Group 5 unmanned aircraft, GA-ASI began the rigorous development of a certified MQ-9.²² The result, is an aircraft, built from the ground up, to integrate into civil airspace as well accept greater wing stores for a wide variety of applications. As development continued, and global consumer interest grew, GA-ASI developed two variants optimized for different environments.²³ The MQ-9B SkyGuardian and MQ-9B SeaGuardian split the domain

²² THE SKY'S [NOT] THE LIMIT, General Atomics Aeronautical Continues to Push RPAS Boundaries (14200 Kirkham Way, Poway, CA 92064: General Atomics Aeronautical Systems, Inc.

²³ Certifiable Predator B, Multi-Role - Single Solution (14200 Kirkham Way, Poway, CA 92064: General Atomics Aeronautical Systems, Inc., 2017).

between land and sea respectively and are more optimized for their respective environments. Consistent with General Berger’s guidance that the Marine Corps be a Naval Expeditionary Force in Readiness, its only appropriate that the service pursue the SeaGuardian as a future POR. Figure 1 provides a basic overview of the physical characteristics and capabilities of the MQ-9B SeaGuardian.

CHARACTERISTICS		FEATURES
Wing Span:	79 ft (24m)	<ul style="list-style-type: none"> • High Definition EO/IR • SeaGuardian Mission Kit: <ul style="list-style-type: none"> – Multimode 360° Maritime Surface Search Radar – Automatic Information System (AIS) • GA-ASI Lynx Multi-mode Radar • Dual VHF/UHF certified radios • Open mission systems architecture • STANAG 4671-compliant type certifiable design • DO-178 and DO-254 design assurance for software and avionics • All weather De-ice/Anti-ice system - Lightning protection • Detect and Avoid (TCAS/ADS-B and Due Regard Radar) • Damage tolerant airframe • 40,000 hour design service life • Automatic takeoff and land (LOS and SATCOM) • Fire protected engine bay • Other customer specific payloads: <ul style="list-style-type: none"> – Electronic Support Measures (ESM) – SIGINT
Length:	38 ft (11.7m)	
Powerplant:	Honeywell TPE331-10 Turboprop	
Max Gross Takeoff Weight:	12,500 lb (5670 kg)	
Fuel Capacity:	6,000 lb (2721 kg)	
Payload Capacity:	4,750 lb (2155 kg) across 9 hardpoints (8 wing, 1 centerline) 800 lb internal (363 kg)	
Power:	45 kVA	
Backup Power:	2 kW	
PERFORMANCE		
Max Altitude:	40,000+ ft MSL	
Max Endurance:	35 hr	
Max Air Speed:	200+ KTAS	
Max Range:	5,500+ nmi	
CONTROL/DATA LINKS		
Line-of-Sight:	C-Band	
Over-the-Horizon:	X-, Ku-, or Ka-Band Backup Inmarsat	

Figure 1: GA-ASI Data Sheet; <http://www.ga-asi.com/mq-9b>

Notable upgrades from the existing fleet of MQ-9A aircraft include the following: increased endurance with internal fuel, increased external payload capacity (4,750lbs across 9 hardpoints), increased endurance to 35hrs, extended range (5,500+ nm) which includes increased combat radius, open software architecture, all-weather de-ice/anti-ice and lightning insulation, Beyond Line of Sight (BLOS) takeoff and landing, Automatic Identification System (AIS), multimode 360° maritime surface search radar, and a Traffic Collision Avoidance System

(TCAS)/Automatic Dependent Surveillance – Broadcast (ADS-B) detect and avoid radar. All together it is a different airframe and dissecting each of the above-mentioned capabilities, it is clear the MQ-9B SeaGuardian succinctly fits into the future Marine Corps Force Design envisioned by General Berger.

One of the many concepts with MALE UAS is to treat the aircraft's persistence like a truck.²⁴ The reliable performance of a type certified airframe serves its customer as power and a ride to the point of employment. That is, the engine, a Honeywell Turboprop capable of 1,600 shaft horsepower and 45kVA of electricity (Figure 1) provides plenty of power to the airframe as well as any number of additional aircraft pods and sensors that would require power to operate. Then the airframe is the aerodynamic instrument to transport the capability to the point of employment. Subsequently, the sky is the limit with additional capabilities across the range of warfighting functions. For example, as F-35's use Multifunction Advanced Data Link (MADL) to communicate amongst other aircraft in their flight, the technology is not proliferated elsewhere in the Marine Corps. Since its security concerns exceed the risk of disseminating it throughout the service, a reasonable solution is the incorporation of Battlefield Airborne Communications Node (BACN) to relay between multiple different waveforms and broadcast to a common data link. The concept is currently under development with the USAF utilizing RQ-4 Global Hawk to relay between F-22 Intra-Flight Data Link (IFDL) and F-35 MADL.²⁵ Incorporating BACN or a similar concept on the MQ-9B would enable General Berger's vision within his CPG by formally connecting our advanced fighters with Marine littoral units ashore

²⁴ LtCol Kristopher L. Faught "Pulling our Weight Marine Aviation's Contribution to Naval Aviation and Force Projection in the 21st Century." (Naval War College, 2018), 23.

²⁵ Valerie Insinna, "Northrop's Fix for F-35 and F-22 Communications Problem Involves Global Hawk Drones," *DefenseNews* (Aug 23, 2017). <https://www.defensenews.com/air/2017/08/23/northrops-fix-for-f-35-and-f-22-communications-problems-involves-global-hawk-uavs/>.

whose Sea Denial task can be realized with accurate targeting data from survivable F-35s operating well within the WEZ during blunt layer operations.

This of course is potentially realized with the new robust design of the MQ-9B airframe. Capable of carrying 4,750lbs across nine stations, the MQ-9B's external payload capacity is increased by 1,750lbs from previous models.²⁶ Like before, this provides unique service opportunities to provide power and a ride to whatever capability the service needs. Aside from BACN and communications bridging, MQ-9B could carry a wide variety of creative munitions. Examples include, AGM-158C Long Range Anti-Ship Missile (LRASM), the Naval Strike Missile (NSM), and GBU-53/B Small Diameter Bomb II (SDB-II) as potential replacements to the AGM-114 Hellfire and Paveway II series precision guided bombs. These examples would allow MQ-9B to achieve greater standoff range from enemy targets counter to current conventional weapons. Outfitting an LRASM along the centerline to negate the effects of an asymmetric load, the MQ-9B's persistence could instantly provide a rapid response to the JFC or Surface Warfare Commander (SWC) executing Sea Control or Sea Denial, where no other platform is persistently available to deliver the munition. Further the concept would be enabled through Manned Unmanned Teaming (MUMT) allowing the survivable F-35 to penetrate forward and the vulnerable MQ-9B to launch at a range. This among other payload concepts are all possibilities of future employment with MQ-9B SeaGuardian in part due to the many upgrades from previous models, in fact it is the airframe itself that guarantees so much utility and flexibility for the Marine Corps.

²⁶ SEAGUARDIAN, Persistent Maritime Domain Awareness (14200 Kirkham Way, Poway, CA 92064: General Atomics Aeronautical Systems, Inc., 2018c). http://www.ga-asi.com/Websites/gaasi/images/products/aircraft_systems/pdf/SeaGuardian_DataSheet_111418.pdf.

The airframe, to any aircraft, is the foundational design that all other capabilities are built around. For the MQ-9B, the design is a first in modern day aviation. With the incorporation of an all-weather capability, extended range, and Due Regard Radar (DRR),²⁷ the aircraft can explore many different options for basing and employment. Previous MQ-9A models, while persistent, could not be expected to fly in poor weather conditions or too far away from their terrestrial based Line of Sight (LOS) Launch & Recovery (LRE) locations. Therefore, MALE UAS had not been considered for employment in INDOPACOM given the vast distances of open ocean required to patrol and transit. Now, with the upgraded capabilities, basing possibilities at Guam and Darwin, Australia, as examples, give the Marine Corps, JFC, and Combatant Commanders, alternatives on or outside of the Second Island Chain. This distinction depicts the possibilities of employment while reducing risk writ large. Figure 2 gives reference to Guam

²⁷ “Due Regard Radar is an air-to-air radar being developed to meet the requirements envisioned to enable Remotely Piloted Aircraft (RPA) to fly in International Airspace. The DRR is comprised of a two panel Active Electronically Scanned Array (AESA) Antenna and a Radar Electronics Assembly (REA) that give the RPA pilot the ability to detect and track aircraft across the same Field-of-View (FOV) as a manned aircraft.” <http://www.ga-asi.com/due-regard-radar-developmental>

and how an MQ-9B could transit 1,500nm out and back to the South China Sea (SCS), and still provide 20+ hours of multi-role support in the operational environment.

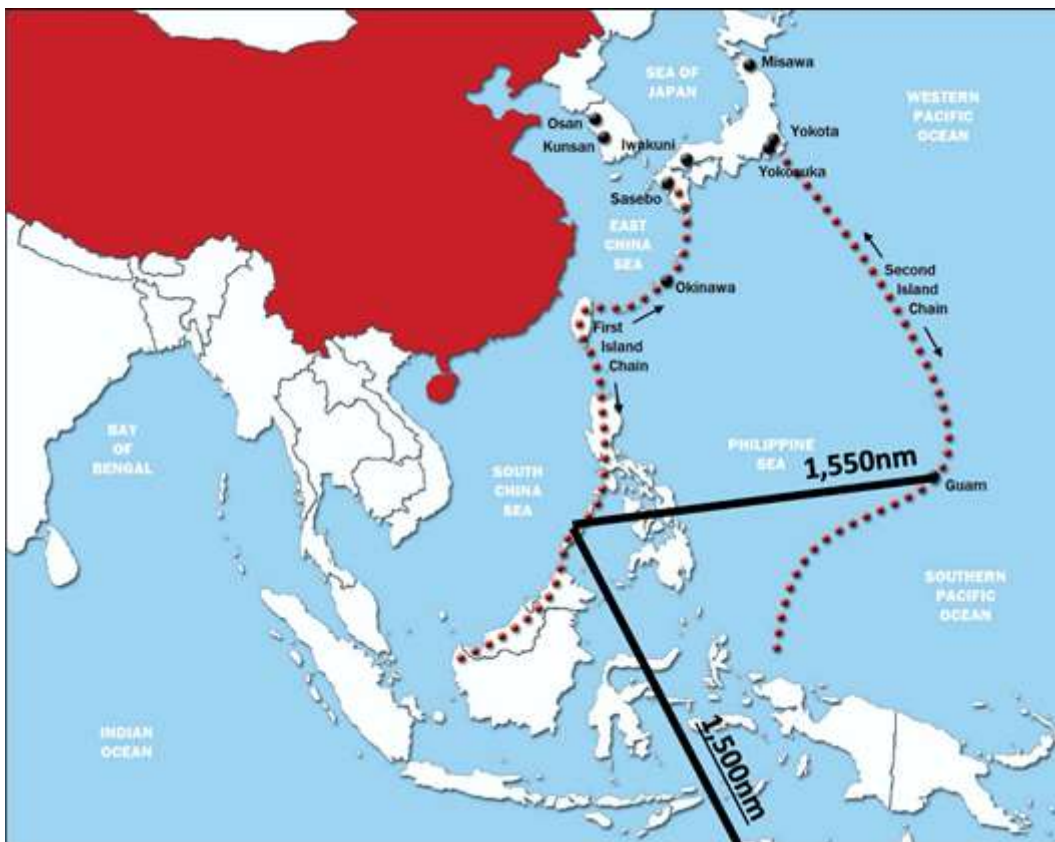


Figure 2: Depicts the range from Guam and Darwin, Australia from the SCS; <https://cofda.wordpress.com/tag/second-island-chain/>

Typically, this abstract assessment of ranges and combat radius would not be valuable unless tested and proven in flight. On July 11th, 2018, GA-ASI made history with the MQ-9B by completing the world's first MALE UAS transatlantic flight.²⁸ Departing from Grand Forks, North Dakota, the aircraft traveled 4,300nm to land at Gloucestershire, England which

²⁸ "GA-ASI SkyGuardian Concludes First Trans-Atlantic Flight of a MALE RPA." JanesDefense Weekly (Jul 03, 2018b), 4. <http://www.ga-asi.com/Websites/gaasi/templates/Canada/img/pdf/historic-transatlantic-flight.pdf>.

demonstrated the aircraft's ability to complete a long transit through civil airspace.²⁹ While the flight demonstration is already a significant accomplishment on the surface, the details are even more promising. The flight took place entirely under BLOS conditions, meaning that neither end required a physical LRE to assume control of the aircraft and recover with a C-Band Line of Sight (LOS) datalink. Furthermore, the aircraft recovered in Gloucestershire with over 2,600lbs of fuel remaining, which would give the aircraft approximately 40% of its total range remaining.³⁰ Both of these facts support concepts of employment in the Pacific. With the demonstrated range and capability to execute terminal area departure and recovery via BLOS data links, the aircraft can minimize its forward posture and extend its logistics hub out to and beyond the second island chain. This drastically reduces the footprint required to sustain the aircraft and project its capabilities beyond the forward edge of Marines in the contact layer. Further, should the extension of capabilities be required in the forward area, MQ-9B's versatility would allow it to recover at forward bases or FARPS without the presence of a dedicated maintenance crew. Conceivably, the aircraft could recover at an airfield of its choosing, taxi and remain in place until a contact team enabled by MV-22 range and speed, could arrive to rearm and refuel. Once complete, the aircraft, through BLOS link back to its parent squadron in Yuma, Arizona, could resume the mission independently. This persistence at range employment method is exactly the capability required to support persistent Marines constantly engaged in the contact layer without imposing the sustainment risk and burden on them for the capability.

Executing this employment method comes with challenges also addressed by GA-ASI. Airborne persistence in the Central Command (CENTCOM) Area of Operations (AOR) is

²⁹ Stephen Carlson, "SkyGuardian Drone Completes Transatlantic Flight from U.S. to U.K." *United Press International* (. <https://www.upi.com/Defense-News/2018/07/12/SkyGuardian-drone-completes-transatlantic-flight-from-US-to-UK/8831531407335/>).

³⁰ "GA-ASI SkyGuardian Concludes First Trans-Atlantic Flight of a MALE RPA.", 4.

different than flight operations in Pacific Command (PACOM) specifically INDO-PACOM.

Figure 3 depicts the average annual temperature and precipitation differences between Helmand Province, Afghanistan and Puerto Princesa, Philippines. Among the most obvious differences between both regions is the temperature and precipitation differential. This comparison is drawn to highlight why legacy MQ-9A aircraft never required all-weather performance. However, as the reliable persistence generated applicability beyond CENTCOM, the requirement for all-weather capability evolved into the redesigned MQ-9B.



Table 1: Annual precipitation comparison, Puerto Princesa, Philippines and Helmand Province, Afghanistan. <https://www.timeanddate.com/>

Beyond weather, another limitation limiting the integration of legacy MQ-9A aircraft into civil airspace was the lack of see and avoid. Traditionally, in manned flight, see and avoid has been accomplished by way of the human eyeball and enhanced through onboard sensors. A pilot observing other airborne traffic and taking measures to avoid the collision of two aircraft is and will always be one of the primary responsibilities of a pilot. However, it's obvious that unmanned aircraft lack this ability inherent to manned aircraft. To mitigate this, the incorporation of TCAS detect and avoid radar and ADS-B into the aircraft navigational system are measures to

be a participant in the avoidance and mitigation of mid-air collisions. This is exceptionally helpful considering the vast stretches of open ocean SeaGuardian would transit to employ itself in the beforementioned scenarios. Furthermore, the incorporation of these systems, particularly TCAS, would satisfy the State-operated “Due Regard” requirement in international waters.³¹ Not only would this enable employment, it would demonstrate good faith in the safe and judicious integration of U.S. aircraft with our allies and partners. In fact, the demand for the MQ-9B among our allies and partners is driving its revolutionary development.

As foreign allies and partners look for increased methods to surveil their coastlines and Economic Exclusion Zones (EEZ), there is increased demand in MALE UAS. For starters, the cost savings are driving other nations to consider unmanned alternatives and when coupled with the recent airworthiness certifications of the MQ-9B, the appeal of the SeaGuardian is hard to turn down. In fact, while the aircraft design is company funded³² the largest segment of its demand has been from international customers, not the United States or United States Marine Corps. The United Kingdom (UK) has been the leading nation behind the development of the MQ-9B land variant, SkyGuardian, which they plan to take delivery of in 2021.³³ Furthermore, other nations with extended coastlines and a vested interest in surveilling its littorals are considering or have decided to procure an MQ-9B variant from GA-ASI. Current demand

³¹ Operation of State Aircraft (Paris, France; ICAO Civil/Military Cooperation Symposium: , 2015). <https://www.icao.int/EURNAT/Other%20Meetings%20Seminars%20and%20Workshops/ICAO%20Civil-Military%20Cooperation%20Meetings/ICAO%20Civil-military%20Cooperation%20Symposium%202015/ICMCS%20IP01.pdf>.

³² Thomas G. Mahnken, Travis Sharp and Grace B. Kim, *Deterrence by Detection: A Key Role for Unmanned Aircraft Systems in Great Power Competition*, Center for Strategic and Budgetary Analysis, (April 2020), 35. <https://csbaonline.org/research/publications/deterrence-by-detection-a-key-role-for-unmanned-aircraft-systems-in-great-power-competition>

³³ Mahnken, Sharp, and Kim, 39.

includes Belgium, Australia, India, and the UK.³⁴ Each country has seemingly recognized the security challenge near their sovereign borders and coastlines and are turning to reliable and cost-efficient technologies to increase their governments awareness of vulnerable regions and take action where appropriate.

Counter Argument – Sitting Duck, USAF, &

With poor maneuverability by design and a high signature, otherwise known as Radar Cross Section (RCS), current MQ-9A aircraft have been long criticized as not survivable against a peer adversary. This is true, the slow speeds, long wingspan, and highly observable surface make the MQ-9 airframe highly vulnerable from surface and air threats. This, however, is irrelevant to the purpose of the aircraft. While survivability may be a necessary trait for many aircraft, such as F-35, it only addresses one aspect of great power competition and ignores the value in deterrence by detection. This strategy, lacking in many service capabilities, places a value of deterrence on the surveillance generated by persistence. This surveillance creates a condition whereupon an adversary constantly recognizes they are under persistent surveillance and therefore less likely to take aggressive action, similar to the criminal deterrence created by persistent law enforcement in a high crime area.³⁵ Therefore, the airframe does not have to be survivable to achieve this effect. Regardless, the critics that accept this argument, contest the application of runway dependent land-based aircraft for the Marine Corps aircraft.

Many within the Marine Corps argue the service does not need MALE UAS, specifically the MQ-9. Instead senior officials and Marine Corps planners have another concept they have

³⁴ General Atomics' SeaGuardian Provides Perfect Platform for Countering Coercion in Maritime Domain, 2019). <https://www.indiastrategic.in/2019/02/16/general-atomics-seaguardian-provides-perfect-platform-for-countering-coercion-in-maritime-domain/>.

³⁵ Thomas G. Mahnken and Grace B. Kim, "Deterrence by Detection: A New Approach to Preventing Opportunistic Aggression," Mar 25, 2020, https://www.realcleardefense.com/articles/2020/03/25/deterrence_by_detection_a_new_approach_to_preventing_opportunistic_aggression_115145.html.

been considering, MAGTF Unmanned expeditionary program (MUX).³⁶ MUX, as the Marine Corps envisions, will be a multi-role Vertically Take Off and Land (VTOL) platform based from the ship. Capabilities include Anti-Air Warfare (AAW), Offensive Air Support (OAS), Electronic Warfare (EW), and Air Early Warning (AEW), among other things. Overall, the concept sounds robust, and with a VTOL launch and recovery the aircraft should be capable of Amphibious shipboard operations. In its current form, MUX is nothing more than a capability concept, no prototypes have been developed or contracts awarded for the research and development, meaning the realistic time horizon for a program of this magnitude is 15 years, 10 years at a minimum.³⁷ Furthermore, the concept of ship-based UAS undermine the Navy's electromagnetic signature control efforts. Ship-based UAS would require power intensive line of sight data links between the ship and aircraft, meaning the aircraft would be unable to provide its primary capability, reconnaissance, during the Navy's most vulnerable moments and under Emissions Control (EMCON).

Further opponents have maintained that the Service shouldn't duplicate other capabilities provided by the Joint force; duplication is not cost effective and it can degrade service technological integration. All of this is absolutely true and continuously problematic for Marine Corps modernization efforts, why waste limited resources on a capability that someone else already provides especially to the tune of 66 continuous worldwide Combat Air Patrols (CAPs) or also referred to as combat lines.³⁸ This argument, while valid, does not account for differences in doctrine, resourcing, aircraft capabilities, or availability across the combatant

³⁶ Robbin Laird, "Evolution of the Marine Corps UAS Capabilities," (Jul 18, 2017). https://www.realcleardefense.com/articles/2017/07/18/evolution_of_the_marine_corps_uas_capabilities_111836.html.

³⁷ Olivia Garard, "Marine Corps Aviation: Let the "guardian Angel" be Your Moneyball and the VMUs Your Oakland A's," War on the Rocks (Jul 31, 2017). <https://warontherocks.com/2017/07/marine-corps-aviation-let-the-guardian-angel-be-your-moneyball-and-the-vmus-your-oakland-as/>.

³⁸ Department of the Air Force, *Fiscal Year (FY) 2020 Budget Estimates*, Operations and Maintenance, March 2019.

commands. For example, the wide applications of the ISR enterprise allocate individual USAF Mission Control Element (MCE) squadrons to specific missions that drive their own independent Mission Essential Tasks (MET). This complicates the availability of all 66 combat lines to support the Marine Corps and Joint Force Maritime Component Commander (JFMCC). Making support more difficult is the suitability of current USAF MQ-9A aircraft outside of United States Central Command (USCENTCOM). As noted earlier, given the evolving nature of global threats, the Marine Corps must have aircraft capable of operating in a variety of climates particularly those in PACOM. Therefore, as General Berger stated in his 2019 planning guidance, the Marine Corps' provides ready forces to the Joint force, which in this case suggests that duplication is irrelevant if it is a desired capability. Further, the significant differences in the MQ-9B airframe challenge the notion that capabilities would be duplicated between the services, particularly since the USAF rejected fielding of the MQ-9B.

In 2017, the House Armed Services Committee (HASC) directed the USAF to evaluate the future of the Remotely Piloted Aircraft (RPA) fleet. Specifically, they directed the Air Force to evaluate upgrading existing inventory of MQ-9A aircraft from the Block 1 to the Block 5, or to consider an entirely new variant in the MQ-9B.³⁹ After evaluation, the USAF claimed that it would ultimately be more cost effective to simply procure additional MQ-9A Block 5 aircraft and forego the added capabilities of the MQ-9B variant. Reasons for the decision include, one billion dollars above a block 5 upgrade, increased logistics challenges with fielding a new aircraft, insufficient existing infrastructure to accommodate a longer wingspan, and current availability among other things.⁴⁰ All of these are compelling reasons why the USAF would not

³⁹ Rachel S Karas, *Fy-18 Defense Policy Bill Mark Includes Mq-9 Cost-Benefit Analysis*, Vol. 28 (Arlington: Inside Washington Publishers, 2017). <https://search.proquest.com/docview/1912532404>.

⁴⁰ Rachel Karas, *USAF: MQ-9B Procurement More Expensive, Riskier than Other Options*, Vol. 34 (Arlington: Inside Washington Publishers, 2018). <https://search.proquest.com/docview/2085609078>.

upgrade their current inventory and important considerations for the Marine Corps when deciding its future ISR capability however, where there are challenges there are also opportunities.

With the decision to defer procurement of the MQ-9B in favor of upgrading the existing RPA fleet, the ISR gap in the Pacific theater is now unfilled. As indicated in *Figure 3*, precipitation is much higher in the Pacific theater and enough to significantly limit current USAF RPA aircraft in INDO-PACOM. This provides the Marine Corps an excellent opportunity to deliver the Joint force a relevant capability not concurrently provided by the Joint force, one which will absolutely be necessary when supporting Marines in the maritime contact layer.

Conclusion

As the Marine Corps continues to reorganize itself to meet the growing security challenges facing the nation, several things are clear. The modern battlefield is increasingly complex. While the fear of nuclear war may have subsided, the vacuum has been filled with other equally complex security challenges. As we evaluate the events reshaping our definition of this new complex security environment, deterrence by denial is necessary to deter adversaries, requiring the persistent presence of the United States. This persistent presence, in the case of adversaries in INDOPACOM, will undoubtedly involve Marines competing in the contact layer.

General Berger has made it clear that the Marine Corps is not properly organized or equipped for the future fight, specifically, the service does not have the personnel, equipment, or operational concepts to win both in the contact or blunt layers. Seeing as though success in the contact layer directly avoids blunt layer confrontation, the Marine Corps must appropriately prioritize force design for competition in the contact layer. Therefore, as the service continues to identify the enabling capabilities required for competition, it is increasingly clear that a

persistent, reliable ISR platform is necessary. The MQ-9B SeaGuardian is this connecting file. Connecting communications, facilitating multi-intelligence collections in the land and maritime domain, and providing lethality, all with a reliable, type-certified unmanned platform unmatched range is the capability the Marine Corps needs to deter and win in the contact layer.



Figure 3: GA-ASI MQ-9B SeaGuardian. <http://www.ga-asi.com/mq-9b>

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