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From: First Lieutenant Walker D. Mills 1467752835/0302 USMC
To: Commanding Officer, 2d Battalion, 1st Marines
Via: Operations Officer, 2d Battalion, 1st Marines

Subj: AFTER ACTION REPORT FROM 1ST BATTALION, 4TH MARINES MARINE CORPS COMBAT READINESS EVALUATION REGARDING SMALL UNMANNED AERIAL SYSTEMS

Ref: (a) Asymmetric Warfare Group Russian New Generation Warfare Handbook
(b) FM 20-3 Camouflage, Concealment and Decoys
(c) Marine Corps Concept for Signature Management
(d) 1/4 MCCRE ExCon Handbook

Encl: (1) Images with Commentary

1. Purpose. To identify strengths and deficiencies observed by the opposition force (OpFor) Fire Support Team (FiST) while supporting 1st Battalion, 4th Marines (1/4) during their Marine Corps Combat Readiness Evaluation (MCCRE) specifically related to their reaction to and employment of small, unmanned aerial systems (SUAS). Lessons learned in training are often limited to those in the exercise force and can be quickly forgotten if not captured in writing, this paper serves to mitigate that risk.

2. Situation. The Echo Company (Warhammer) FiST was tasked with providing long-range fires to disrupt and delay 1/4 for the duration of their MCCRE in imitation of contemporary Russian fire support assets and tactics. The MCCRE was a battalion-reinforced, non-live fire, free-play exercise conducted across Camp Pendleton from 24 to 29 June, 2018. This paper is written from the perspective of Warhammer FiST.

- a) Tactics. The FiST was tasked with imitating a small, mobile observer team capable of calling massed, long-range, indirect fire fires (IDF). The FiST generally operated independent of Warhammer at distances of 2-10km. The FiST was capable of flying the SUAS on the move and employed them out ahead of the FiST to rapidly identify enemy vehicle assets, key terrain, and areas of interest. After identification by SUAS the FiST moved to a location where the target could be visually identified and initiated a call for fire (CFF). Early in the exercise the FiST relocated often to limit the chance of compromise by the enemy, but later in the exercise the FiST remained static for longer periods because the Exercise Control (ExCon) wanted 1/4 to identify their positions.
- b) Organization. The FiST was manned by (1) 0302 Infantry Officer who was the FiST leader, radio operator and forward observer; (1) 0311 Rifleman qualified to drive a utility task vehicle (UTV) who served as a driver and sentry and (1) or (2) 0231 Intelligence Specialists qualified to fly the RQ-11 Raven SUAS who served as operators and analysts. Our mission essential gear was a PRC-117 radio, an AN/PES Vector 21B and a AN/PSN-13 DAGR.
- c) Limitations. The limitations of the MCCRE were limitations inherent to all exercises of this size and type. With the available radios it was difficult to maintain two way communication with Warhammer at times but the FiST was still able to maintain awareness of the battle space through communication with ExCon. Additionally, because all the fires were notional, the FiST never experienced friction from the delivery side of the targeting cycle. The notional supporting assets were always ready to provide accurate, and immediate support. On the opposite side, the FiST was limited in their ability to prosecute fire missions by ExCon, with nearly two thirds of all missions denied. The casualties painted for accurate strikes were far too light to be realistic and units were revived almost immediately. These limitations are understood as being important the goals of the exercise and have already been taken into account by the author.

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- d) Scope. This after action review is not for 1/4, it is for the rest of Marine Corps. 1/4 has surely internalized these lessons through their training already. The author is not trying to denigrate 1/4, and in all likelihood any other battalion would have performed similarly. That the actions of 1/4 during their MCCRE come across poorly is an indication of the unpreparedness across the entire force for the SUAS threat.

3. Camouflage and Concealment

- a. Discussion. 1/4 did not effectively employ camouflage for their positions, vehicles or Marines at the individual level. Mild attempts were made that included occasional use of camouflage netting on vehicles or efforts to attach foliage to vehicles for the Light Armored Reconnaissance (LAR) platoon. Often Marines and vehicles were left in the open against a contrasting background that highlighted the asset in question. This repeatedly occurred in close proximity to trees and bushes that would have provided effective concealment. When camouflage netting was employed it was often simply draped over vehicles and not staked out to conceal the outline or blend into the landscape. This lack of camouflage made it very easy for the FiST to identify targets, vehicles in the open could be identified on the first pass of the SUAS or at a glance from an observer. The FiST estimates that over the course of the exercise it identified over 100 separate vehicle positions to CFF on. This number is larger than the total number of vehicles supporting 1/4 and leads the FiST to believe that within the first 96 hours of operations a single observer team would have been able to target and destroy every vehicle employed by 1/4. At no time was the FiST unable to find a unit of 1/4 they were looking for and they were able to effectively battle track the entire battalion with only a single SUAS. Occasionally the FiST had equal or superior battlefield awareness to ExCon.
- b. Recommendation. Camouflage and concealment at all levels needs to become a priority. When selecting positions for individual riflemen to the battalion combat operations center (COC) the availability of concealment and the surrounding environment needs to be taken into account. Camouflage netting colored appropriately for the environment needs to be SL-3 to every vehicle and the drivers trained in effective employment so that immediately upon stopping they can employ it and vehicles need to be painted with camouflage appropriate for their environment. Furthermore, units should consider issuing smaller camouflage nets to individual Marines depending on the situation. Tarps, while printed with camouflage, are easily identified from the air because of their square shape, sheen, and dark color; the FiST was often able to identify dismounted infantry initially because they set up tarps to shade themselves. Effective and tested tactics, techniques and procedures exist and can be found in FM 20-3 *Camouflage, Concealment and Decoys*. Additionally, OpFor was able to effectively camouflage units from UTVs to a 60mm Mortar Section against observation by SUAS, for images of their efforts see Enclosure (1).

4. Counter SUAS Capability

- a. Discussion. 1/4 had no counter SUAS (C-SUAS) capability throughout the exercise. SUAS was able to loiter over their positions at an altitude of only a few hundred feet, where it was clearly visible and audible to the Marines. While overhead the SUAS was continually pulling accurate grids for their positions and providing observation for refinements and adjustments. It was also a significant threat to morale because the whine of SUAS meant IDF was following shortly
- b. Recommendation. Infantry battalions need an organic C-SUAS capability at the platoon level or below. Kinetic and non-kinetic options are available commercially but not fielded by our force. Units need to signal up the chain of command that organic, C-SUAS capability is their number one acquisition priority.

5. SUAS Battle Drill

- a. Discussion. 1/4 did not have a clear C-SUAS Battle Drill. Sometimes Marines did not report sightings of SUAS to their higher or respond in any observable way. The most common reaction observed was for Marines to point at the circling SUAS with their hands or rifles and take no further action. It usually required points of IDF and casualties to prompt a reaction to the SUAS.

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- b. Recommendation. Observation by enemy SUAS on the battlefield must be regarded the same as visual contact with armed combatants. The threat of being observed by a SUAS employed by an observer who can communicate with IDF assets is far greater than the threat of being observed by a fire team or squad possessing small arms or a machine gun. The basic outline for a SUAS Battle Drill should be immediate dispersion, movement to a better concealed position, reporting to higher, and an attempt to scan the area for observers. None of this was present in the actions of 1/4.

6. Defensive Posture

- a. Discussion. 1/4 was expected to develop a battalion defense comprised of mutually supporting and entrenched company battle positions. This took place on the last day of the exercise. Before the defense was fully established the position of all three line companies had been identified by the FiST. ExCon denied fire missions, but with the templated Russian systems the battalion would have been annihilated before the first Lance Corporal had opened his E-Tool. Later in the day one of the ExCon commented over the radio that this was a “we see them and they see us” situation. The tactical translation is that a single observer team could have annihilated a Marine battalion.
- b. Recommendation. A static, entrenched defense is no longer a tenable tactic for Marines to employ against an enemy equipped with SUAS and long-range fires. A defense in this environment needs to prioritize concealment, distribution, and mobility; utilizing an ambush mentality. To be found is to be targeted, and to be targeted is to be killed. Digging a doctrinal company defense is a sure way to get found and targeted. The FiST was able to identify all the elements of 1/4 faster and more accurately when they were in the defense than at any other time.

7. Denied Observation Actions and Key Terrain Identification

- a. Discussion. The FiST often relied on specific types of terrain to observe 1/4 and employ their SUAS assets. They were more effective when employed from high ground where they could look down from above and their range was extended. It was also advantageous to employ SUAS from terrain that offered concealment for the operators and their vehicle in the form of trees and bushes. The FiST expected to be compromised by observers and patrols from 1/4 that were attempting to control the same key terrain as the Warhammer FiST. This did not happen, throughout the exercise the FiST was compromised only twice, once when moving through an active engagement area at high speed and once after ExCon asked that they make themselves more obvious to the exercise force they were observing. The FiST had uncontested access to the most favorable terrain for observation and SUAS employment throughout the MCCRE. The same principles apply to their radio communications, the FiST needed to maintain continuous, two-way communications in order to operate. Because the FiST often sought terrain ideal for employing Very High Frequency radios it found itself co-located with 1/4 re-transmission sites multiple times.
- b. Recommendation. 1/4 could have significantly hampered and reduced FiST operations by identifying and contesting the key terrain for observers in their area of operations (AO). Small patrols along the ridgeline would have prevented the FiST from occupying their positions and dramatically reduced the range of their observation. Patrols into the few areas with trees and large bushes would have forced the FiST into the open where they could have been more easily identified. Identification of key terrain for observers and SUAS assets allows for that terrain to be contested and controlled, reducing the ability of the enemy to effectively observe and communicate.

8. Effective SUAS Employment

- a. Discussion. Through observation of 1/4's SUAS employment the FiST was able to draw conclusions about their tactics. 1/4 only launched SUAS after they had established their positions, as if it was an afterthought. This implies that they were employing their SUAS as a security asset by overflying their own position, not as a reconnaissance, screening, or targeting asset. Every company of 1/4 had an organic SUAS asset as well as the LAR platoon, despite this some companies never flew their SUAS for the duration of the exercise. The

FiST was able to effectively observe, identify and target 1/4 SUAS assets – taking them out of the fight. 1/4 SUAS operators were unable to identify key terrain for their operations or use their SUAS to effectively support their scheme of maneuver.

- b. Recommendation. SUAS is best employed in support of specific tasks like targeting or locating specific units. Left un-tasked, SUAS is a waste of resources. To employ it effectively commanders need to understand the capabilities and integrate SUAS in their scheme of maneuver. SUAS is also capable of being flown on the move, the FiST was able to fly their SUAS while moving to reconnoiter routes ahead of their movement, continue targeting enemy forces during their egress, disrupt forces before moving into position or maintain observation and targeting capability while moving between positions. SUAS is a key asset; to be employed effectively units need redundant SUAS systems and redundancy in their operators so a single casualty cannot remove this key capability from the fight.

9. Deception

- a. Discussion. At no point did the FiST observe 1/4 using deception to support their scheme of maneuver. Deception is a highly effective tool in warfare and should be part of everything we do. Targeting that relies heavily on SUAS observation is especially vulnerable to deception.
- b. Recommendation. 1/4 could have integrated deception into their scheme of maneuver and it would have most likely disrupted the FiST or mitigated their effectiveness. Relatively simple, low-fidelity methods like decoys, setting up a fake COC, fake antenna farms, or deliberate movements in the wrong direction would have foiled the FiST at a relatively low cost to 1/4.

10. Conclusions. SUAS is here, and it is here to stay. The ability of small units and single observers to look down on their enemies from miles and kilometers away is going to change the way that infantry fights and maneuvers. These changes are already being realized in Syria, Iraq and the Ukraine. The Marine Corps must adjust the way we fight to account for the SUAS threat and the threat of small, highly mobile, distributed observer teams, and we need to rapidly develop effective tactics, techniques and procedures (TTPs) for effectively employing SUAS assets ourselves. The lessons learned from the 1/4 MCCRE need to be considered across the force as indicative of an endemic problem and simulate a call to action. It also needs to be noted that the RQ-11 SUAS employed during the MCCRE is an outdated technology that is not lethal or autonomous. Recent advances in autonomy, and the weaponization of SUAS will further change the threat. SUAS are still in their infancy, and most of the best practices for employment remain undiscovered. We need to make sure that we use exercises like the MCCRE to develop these TTPs and prepare our battalions to face these threats. Even at the cost of other training we need to train to effectively employ and counter the SUAS threat or we risk falling being our adversaries in a critical arena. History shows us that it often not the inventor of a new technology but the force that figures out how to employ it effectively that gains a decisive and disruptive advantage in the battle space.

11. The point of contact for this paper is 1stLt Walker Mills at Walker.Mills@usmc.mil.

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Enclosure (1)

The following images were taken with an RQ-11 Raven UAS during the conduct of the 1/4 MCCRE by Warhammer FiST. The images and commentary are not meant to highlight any unit or part of a unit but to stress the overall need for the Marine Corps to prioritize camouflage and concealment from UAS observation. The commentary represents only the views of the author and a fuller discussion can be found in the body of the document.

Lat/Lon: N 33° 23' 38.98" W 117° 18' 41.12"
Alt: 2014 ft MSL
Mag: 185°



Gimbal
FOV Data:
Slant Rng: 1500 m
CFOV Hdg: 36°
CFOV Lat/Lon: N 33° 24' 16.37" W 117° 18' 07.94"
Horiz. FOV: 10.8°

Description: TAA for 1/4 on day 1.

Discussion: The TAA has no attempt at concealment or security and was in range of OpFor SUAS assets. OpFor was able to accurately count all vehicles and gauge the size of the adversary force. Call for fire was denied.

Recommendation: C-UAS measures should be taken even in the TAA. Units should regard the TAA as an area within range of enemy observation and fires.

Lat/Lon: N 33° 18' 58.99" W 117° 27' 02.48"
Alt: 1499 ft MSL
Mag: 323°



Gimbal
FOV Data:
Slant Rng: 242 m
CFOV Hdg: 286°
CFOV Lat/Lon: N 33° 19' 01.24" W 117° 27' 09.64"
Horiz. FOV: 6.7°

Description: Vehicles IVO the FLOT on day 2.

Discussion: Security elements at the FLOT have taken no camouflage or concealment measures.

Recommendation: All vehicles should employ their own camouflage through netting and foliage that mimics the surrounding environment regardless of their position on the battlefield.

Lat/Lon: N 33° 19' 00.03" W 117° 26' 22.35"
Alt: 1483 ft MSL
Mag: 210°



Gimbal
FOV Data:
Slant Rng: 600 m
CFOV Hdg: 131°
CFOV Lat/Lon: N 33° 18' 49.83" W 117° 26' 09.46"
Horiz. FOV: 17.9°

Description: Dismounted company moving along a road IVO the FLOT on day 2.

Discussion: Dismounted troops are difficult to identify with the RQ-11 unless they contrast with their background. Moving along a light colored road with dark uniforms provides this contrast.

Recommendation: Unit leader move dismounted troops off of roads to improve concealment and pay attention to the color of their uniforms and the background.

Lat/Lon: N 33° 18' 47.71" W 117° 26' 23.04"
Alt: 925 ft MSL
Mag: 192°



Gimbal
FOV Data:
Slant Rng: 361 m
CFOV Hdg: 84°
CFOV Lat/Lon: N 33° 18' 48.18" W 117° 26' 12.34"
Horiz. FOV: 6.7°

Description: Gun truck providing security IVO the FLOT on day 2.

Discussion: The vehicle is partially camouflaged with netting. It is clear that if the netting covered the entire vehicle it would be difficult to identify. The vehicle color does not match the background or the netting.

Recommendation: To be effective camouflage needs to match the background and be fully employed.

Lat/Lon: N 33° 18' 59.68" W 117° 26' 21.42"
Alt: 935 ft MSL
Mag: 13°



Gimbal
FOV Data:
Slant Rng: 737 m
CFOV Hdg: 159°
CFOV Lat/Lon: N 33° 18' 38.58" W 117° 26' 11.29"
Horiz. FOV: 6.7°

Description: Dismounts in security IVO the FLOT on day 2.

Discussion: Dismounted troops in terrain that matches their uniforms are difficult to identify.

Recommendation: Troops should be kept off roads and away from open areas and vehicles. Individuals and groups who apply effective camouflage are difficult to identify.

Lat/Lon: N 33° 20' 31.03" W 117° 25' 02.64"
Alt: 817 ft MSL
Mag: 234°



Gimbal
FOV Data:
Slant Rng: 1060 m
CFOV Hdg: 182°
CFOV Lat/Lon: N 33° 19' 57.05" W 117° 25' 04.16"
Horiz. FOV: 10.8°

Description: MTRV convoy kicking up dust IVO Pulgas Canyon, day 2.

Discussion: Some roads, vehicles and environmental conditions cause units to create secondary signatures like dust clouds which easily give away their position

Recommendation: Routes should be chosen to mitigate observation and risk.

Lat/Lon: N 33° 19' 36.78" W 117° 25' 53.39"
Alt: 1000 ft MSL
Mag: 223°



Gimbal
FOV Data:
Slant Rng: 342 m
CFOV Hdg: 133°
CFOV Lat/Lon: N 33° 19' 31.34" W 117° 25' 47.33"
Horiz. FOV: 17.9°

Description: Dismounted company movement IVO Pulgas Canyon, day 3.

Discussion: Shadows and dark uniforms stand out against light backgrounds. When possible movements should be made through terrain that mitigates observation.

Recommendation: Routes should be chosen to mitigate observation and risk. If these Marines were moving just off of the road they would be difficult or impossible to identify.

Lat/Lon: N 33° 21' 58.95" W 117° 27' 52.50"
Alt: 1391 ft MSL
Mag: 97°



Gimbal
FOV Data:
Slant Rng: 192 m
CFOV Hdg: 6°
CFOV Lat/Lon: N 33° 22' 03.41" W 117° 27' 51.52"
Horiz. FOV: 10.8°

Description: Dismounts and
LAV-25s IVO Horno
Combat Town, day 3.

Discussion: UAS operators
are visible at the bottom of
the image and have made no
attempt to conceal
themselves or their work.
Despite the attempt to
camouflage the vehicles with
netting and foliage their
location makes them stand
out.

Recommendation: UAS
operators should camouflage
themselves and disguise
their activity. Vehicles need
to be parked in locations that
facilitate concealment.

Lat/Lon: N 33° 21' 41.09" W 117° 28' 18.66"
Alt: 1404 ft MSL
Mag: 160°



Gimbal
FOV Data:
Slant Rng: 215 m
CFOV Hdg: 85°
CFOV Lat/Lon: N 33° 21' 41.30" W 117° 28' 13.10"
Horiz. FOV: 31.5°

Description: Dismounts on the road IVO Horno Combat Town, day 3.

Discussion: UAS assets have thermal imaging capabilities that can see through darkness. Roads are often hotter than the surrounding terrain and troops stand out against them even in the dark.

Recommendation: Keep troops off of roads even during times of darkness. If the troops moved off to the sides of the road they would blend into the landscape.

Lat/Lon: N 33° 22' 17.12" W 117° 29' 22.05"
Alt: 1519 ft MSL
Mag: 57°



Gimbal
FOV Data:
Slant Rng: 500 m
CFOV Hdg: 329°
CFOV Lat/Lon: N 33° 22' 29.58" W 117° 29' 30.50"
Horiz. FOV: 10.8°

Description: Company in a hasty position IVO the Alpha Shelf, day 4.

Discussion: This company has halted and taken no measures for concealment or camouflage. Their pack arrangement makes it easy for UAS to identify them and count their number. Tarps are easy to identify from above.

Recommendation: Keep troops off of roads during halts and have them maintain their packs with them. Do not keep vehicles in the center of your position. Do not allow tarps in you position.

Lat/Lon: N 33° 22' 35.29" W 117° 29' 31.69"
Alt: 1397 ft MSL
Mag: 228°



Gimbal
FOV Data:
Slant Rng: 351 m
CFOV Hdg: 172°
CFOV Lat/Lon: N 33° 22' 25.51" W 117° 29' 31.23"
Horiz. FOV: 31.5°

Description: The same company in a hasty position IVO the Alpha Shelf, day 4, zoomed out.

Discussion: This company has ample terrain for concealment but has decided to stay on the road. Moving into the trees and bushes would conceal the company and keep troops in the shade.

Recommendation: When halted move into bushes or trees immediately. Do not halt in the open. Take advantage of natural concealment whenever possible.

Lat/Lon: N 33° 22' 21.81" W 117° 29' 30.80"
Alt: 1194 ft MSL
Mag: 80°



Gimbal
FOV Data:
Slant Rng: 197 m
CFOV Hdg: 347°
CFOV Lat/Lon: N 33° 22' 26.61" W 117° 29' 31.19"
Horiz. FOV: 6.7°

Description: The same company in a hasty position IVO the Alpha Shelf, day 4, zoomed in.

Discussion: UAS operators are visible and have made no attempt to conceal themselves or their work. Despite the attempt to camouflage the vehicles with netting their location makes them stand out.

Recommendation: UAS operators should camouflage themselves and disguise their activity. Vehicles need to be parked in locations that facilitate concealment.

Lat/Lon: N 33° 26' 18.74" W 117° 31' 13.48"
Alt: 1178 ft MSL
Mag: 150°



Gimbal
FOV Data:
Slant Rng: 517 m
CFOV Hdg: 84°
CFOV Lat/Lon: N 33° 26' 19.91" W 117° 30' 56.75"
Horiz. FOV: 6.7°

Description: Camouflaged gun truck in security, IVO Mateo Canyon, day 5.

Discussion: This vehicle has made an attempt at camouflage but their netting does not match the surrounding foliage.

Recommendation:
Camouflage equipment needs to match the environment to be effective.

Lat/Lon: N 33° 26' 37.82" W 117° 31' 22.34"
Alt: 1397 ft MSL
Mag: 213°



Gimbal
FOV Data:
Slant Rng: 407 m
CFOV Hdg: 128°
CFOV Lat/Lon: N 33° 26' 31.89" W 117° 31' 13.74"
Horiz. FOV: 6.7°

Description: Company CP
IVO Mateo Canyon, day 5.

Discussion: This company
has built a small CP with
tarps and packs.

Recommendation: This
should have been done in
conjunction with natural
camouflage and
concealment. If there is not
they should have distributed
their packs instead of
concentrating them.

Lat/Lon: N 33° 26' 24.06" W 117° 31' 33.40"
Alt: 1453 ft MSL
Mag: 169°



Gimbal
FOV Data:
Slant Rng: 364 m
CFOV Hdq: 59°
CFOV Lat/Lon: N 33° 26' 27.44" W 117° 31' 25.72"
Horiz. FOV: 10.8°

Description: Defensive position IVO Mateo Canyon, day 5.

Discussion: This unit has staked out tarps over their fighting holes, making them easy to identify and count.

Recommendation: Tarps are easy to identify from above because of their square shape, color and sheen.

Lat/Lon: N 33° 27' 11.45" W 117° 30' 03.21"
Alt: 1010 ft MSL
Mag: 197°



Gimbal
FOV Data:
Slant Rng: 254 m
CFOV Hdg: 143°
CFOV Lat/Lon: N 33° 27' 07.37" W 117° 30' 00.11"
Horiz. FOV: 10.8°

Description: Warhammer
FiST position IVO Mateo
Canyon, day 5.

Discussion: The FiST has
used netting and natural
foliage to conceal
themselves and their UTV
from UAS observation. They
were not compromised
despite enemy UAS making
multiple passes directly
overhead at low altitude.

Recommendation: When
employed appropriately,
netting supplemented by
natural foliage in a vegetated
area can be successful
concealment.

Lat/Lon: N 33° 27' 31.33" W 117° 31' 28.04"
Alt: 1548 ft MSL
Mag: 202°



Gimbal
FOV Data:
Slant Rng: 330 m
CFOV Hdg: 120°
CFOV Lat/Lon: N 33° 27' 26.94" W 117° 31' 20.28"
Horiz. FOV: 6.7°

Description: Warhammer
Mortars position IVO Mateo
Ridge Road, day 5.

Discussion: The 60mm
Section has used natural
foliage to conceal
themselves from UAS
observation. They were not
compromised despite enemy
UAS making multiple passes
directly overhead at low
altitude and enemy LAV-25s
passing within 100m of their
position

Recommendation: Natural
foliage alone can be
effective concealment
against aerial and ground
based observation.