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LCDR Matthew M. Graham, USN

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14. ABSTRACT

Technological advancements have changed the landscape of warfare, which in turn has changed how the operational commander develops plans to employ forces to achieve the objectives. Unmanned aerial systems (UAVs) have proven over the years that their effective employment greatly enhances the commander's situational awareness and provides a force multiplier, especially in high risk operations. It may also be said that UAVs have become an essential asset in the operating area. Unmanned surface vehicles (USVs) have been an element of the operating forces since as early as World War II, but are now emerging with increased capabilities into the mainstream of operational assets.

Security in the maritime domain, whether it be protecting port facilities or maintaining the security of shipping lanes through international straits, is essential to both the global economy and military freedom of action. Piracy, transnational terrorism, fast attack craft, mines, and submarines all pose significant threats to both civilian merchants and military vessels. This paper addresses the unmanned surface vehicles that are currently in service or in development and their role to support the operational commander in countering those threats and achieve the desired objectives. With extremely capable optical, acoustic, and even weapons packages, USVs must be considered in the operational commander's planning and decision processes for maritime security as well as across a broad spectrum of military operations.

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UNMANNED SURFACE VEHICLES :
An Operational Commander's Tool for Maritime Security

by

Matthew M. Graham

Lieutenant Commander, USN

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

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Abstract

Technological advancements have changed the landscape of warfare, which in turn has changed how the operational commander develops plans to employ forces to achieve the objectives. Unmanned aerial systems (UAVs) have proven over the years that their effective employment greatly enhances the commander's situational awareness and provides a force multiplier, especially in high risk operations. It may also be said that UAVs have become an essential asset in the operating area. Unmanned surface vehicles (USVs) have been an element of the operating forces since as early as World War II, but are now emerging with increased capabilities into the mainstream of operational assets.

Security in the maritime domain, whether it be protecting port facilities or maintaining the security of shipping lanes through international straits, is essential to both the global economy and military freedom of action. Piracy, transnational terrorism, fast attack craft, mines, and submarines all pose significant threats to both civilian merchants and military vessels. This paper addresses the unmanned surface vehicles that are currently in service or in development and their role to support the operational commander in countering those threats and achieve the desired objectives. With extremely capable optical, acoustic, and even weapons packages, USVs must be considered in the operational commander's planning and decision processes for maritime security as well as across a broad spectrum of military operations.

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INTRODUCTION

Unmanned aerial vehicles (UAVs) are operated by all branches of the U.S. military, several government agencies, as well as various militaries around the world. UAVs broke into the mainstream with well publicized successes supporting reconnaissance operations during Operation Desert Storm. Since then, with advancements in surveillance and communications equipment, as well as improvements in airframes and engines, UAVs have solidified their utility in military operations. As of October 2006, coalition UAVs, exclusive of hand-launched systems, had flown almost 400,000 flight hours in support of Operations Iraqi Freedom and Enduring Freedom.[1] Unmanned systems have proven their worth in a vast array of mission areas, including interdiction, force protection, signals collection, reconnaissance, surveillance, and target acquisition. According to some reports, these assets are no longer a "nice-to-have" capability; they are essential to the armed forces' ability to conduct modern warfare.[2] But modern warfare is not only conducted from the air.

The majority of conflicts must include troops on the ground, and UAVs provide those troops exceptional support. But how did those troops, and more importantly their equipment, get to the area of operation? For the most part, the answer is by sea. Since September 11, 2001, Military Sealift Command (MSC) ships have played a vital and continuing role in the global war on terrorism. As of July 2008, MSC ships had delivered more than 12 billion gallons of fuel and had moved 100 million square feet of combat equipment and supplies to U.S. and coalition forces engaged in Operations Enduring Freedom and Iraqi Freedom.[3] In order for those ships to first transit from their port of origin, the sea lanes of communication need to be secure. Upon arriving at the destination, it was necessary for the receiving port

facilities to be accessible and secure. Mines, submarines, surface combatants, pirates and maritime terrorists have the ability to impede the transit or delivery at a variety of locations.

The overall security in the maritime domain is not solely a concern of the military when moving combat forces to and within an operating area. The same threats experienced by the military may also negatively impact maritime trade and the global economy. More than 80 percent of the world's trade travels by water and forges a global maritime link. About half the world's trade value, and 90 percent of the general cargo, are transported in containers. Potentially more important, 75 percent of the world's maritime trade along with half of its daily oil consumptions passes through only a handful of international straits and canals as it moves between the roughly 30 primary megaports/cities in Asia, North America and Europe.[4] Thus, the safety, economic security and prosperity of nations depend on the secure use of the world's oceans.[5]

The increasing requirement for securing the world's oceans, especially international transit straits and port facilities, against a plethora of threats has placed additional requirements upon the U.S. Navy and operational commanders. Vice Admiral Cosgriff, Commander, U.S. Naval Forces Central Command (COMUSNAVCENT) recently discussed the role of maritime security in the Arabian Gulf, which builds a foundation for regional security and global prosperity. He stated, "From security arises stability, which enables and enhances trade, promotes economic activity and increases local and global prosperity." [6] Although VADM Cosgriff was discussing his area of responsibility, the same logic can be applied to any region of the world.

The ever growing obligation to establish and maintain security in the maritime domain has increased the requirements of the operational commander and the forces without a

significant increase in overall force size. With effective integration and employment as they are introduced into the fleet, unmanned surface vehicles (USVs) will provide a tremendous force multiplier in the same manner UAVs have accomplished over the past 20 years.

HISTORY

Unmanned surface vessels have been used for a variety of military operations as early as World War II. Rudimentary drone boats were used to obtain early samples of radioactive water after each of the atomic bomb blast tests during Operation Crossroads.[7] During military operations in Viet Nam, a 23-ft fiberglass hull boat was modified and assigned to Mine Division 113 at Nha Be to operate as a remotely controlled chain drag minesweeper.[8] In more recent history, USVs have been employed to tow targets or act as target drones for live fire exercises. Technology is available to take these early USV platform concepts and develop tremendously capable assets with long endurance, low observability, agility and high speed to carry out the Sea Power 21 mission areas.[9] Leveraging these capabilities within the operational factors complement the conventional maritime forces in a manner similar to the roles UAVs have supported ground forces. The Naval War College report of the Global 2001 war game stated that "USV's were key contributors in establishing situational awareness in the littoral and have shown the potential to provide critical access to high risk areas."[10] It is this situational awareness that is essential for the operational commander to determine the appropriate courses of action to achieve freedom of action in the maritime environment as well as the interface between the sea and land.

Starting with an initial workshop held 28 July 2004 at Naval Weapons Development Center (NWDC) in Newport, RI, representatives from 22 organizations and 13 commands began to identify and prioritize naval warfare mission capabilities where USV's can

contribute. In 2006, the USV Master Plan Study Team was chartered by the Program Executive Officer for Littoral and Mine Warfare (PEO(LMW)). The tasking was to develop the Department of the Navy's Unmanned Surface Vehicles Master Plan to guide USV development in effectively meeting the Navy's present and future needs to support the Sea Power 21 Pillars of Sea Strike, Sea Basing, Sea Shield, and ForceNet.[11] The final report approved by PEO(LMW), with concurrence from the Directors of Surface Warfare (OPNAV N86) and Expeditionary Warfare (OPNAV N85) was released in July 2007.

MISSIONS AND CLASSIFICATIONS

The USV Master Plan Study Team analyzed Navy and Department of Defense guidance and generated a set of USV missions to guide future development efforts. This mission set was developed as a result of two major workshops, substantial Core Team analysis and several Flag briefings. The missions determined to be accomplished by future USVs in priority order are:

- Mine Countermeasures (MCM)
- Anti-Submarine Warfare (ASW)
- Maritime Security
- Surface Warfare (SUW)
- Special Operations Forces (SOF) Support
- Electronic Warfare (EW)
- Maritime Interdiction Operations (MIO) Support

Following the determination of potential mission sets, the Master Plan Team analyzed the key attributes associated with each mission and compared the craft types and vehicle attributes against the mission needs.[12] The end result of the analysis was the establishment of the four classes of USVs described in the following paragraphs:

<u>X-Class</u>

The X-Class is a small (defined as 3m or less), non-standard class of systems capable of supporting SOF requirements and MIO operations. It provides a "low-end" Intelligence, Surveillance, Reconnaissance (ISR) capability to support manned operations and is launched from small manned craft such as the 11m Rigid Hull Inflatable Boat (RHIB) or the Combat Rubber Raiding Craft (CRRC).[13] The X-Class, primarily based on its size, is limited in endurance, payload capability, and seakeeping abilities. Endurance will ultimately be based on the payload.

Figure 1: Example of "X-Class" USV
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: cover)

Figure 2: SEA OWL Mk II USV
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: cover)

Harbor Class

The Harbor Class is based on the Navy standard 7m RHIB. The established primary missions for the class are Maritime Security and Electronic Warfare with the ability to carry a robust ISR capability and a mix of lethal and non-lethal armament. Secondary missions include Mine Countermeasures, Surface Warfare, SOF Support, and MIO Support. The 7m RHIB provides an ideal chassis for the Harbor Class since it is supported by the majority of Fleet units. The Harbor Class will have a typical endurance of 12 hours and be capable of operating at speeds in excess of 35 knots.[14]

Figure 3: Example of Harbor Class USV
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: 38)

Figure 4: Spartan Scout USV
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: 6)

Snorkeler Class

The Snorkeler Class is a semi-submersible vehicle (SSV) of approximately 7m in length. The vehicle is submerged with only its snorkel above the surface. This mode of operation provides a much more stable platform while operating in high seas. It will have a typical endurance of approximately 24 hours with a maximum speed of 15 knots. The primary missions for the Snorkeler Class are Mine Countermeasures to include towing playloads, Anti-Submarine Warfare and Electronic Warfare, as well as a secondary mission of Surface Warfare with the capability to deploy torpedoes. It is also capable of supporting special missions that take advantage of its relatively stealthy profile.[15]

Figure 5: Deploying Snorkeler Class USV
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: cover)

Figure 6: Snorkeler Class USV Underway
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: 6)

Fleet Class

The Fleet Class is a purpose built craft, consistent with the handling equipment and weight limitations of the current 11m RHIB. The primary missions of the class are Mine Countermeasures, Anti-Submarine Warfare, Surface Warfare, and Electronic Warfare, with secondary missions of Maritime Security and SOF support. The typical endurance is 48 hours or more but the operating characteristics are based on the mission the vehicle is configured to support. In a mine countermeasure role and towing sweep gear, the Fleet Class" is limited to approximately 20-24 kts. If relieved of the resistance of towing gear, the vehicle can operate at speeds of 32-35 kts.[16]

Figure 7: Fleet Class USV with Tow Gear
(Program Executive Officer, Littoral and Mine Warfare. *The Navy Unmanned Surface Vehicle (USV) Master Plan* [23 July 2007]: cover)

Figure 8: Protector USV
("Protector Unmanned Surface Vehicle," *Defense Update - International Online Defense Magazine*, no. 2 [2006])

Capabilities

Payload packages installed on existing USVs or in development for future craft are in direct proportion to the size of craft, which delineates the mission sets that a class can accomplish. Larger craft like the Fleet Class can maintain stability while carrying more weight and are therefore capable of carrying more extensive payloads like mine countermeasure sweep gear. But a capability that is resident across all classes of USVs is surveillance and reconnaissance. Advancements in infra-red and electro-optical sensors,

especially the reduction in size and power requirements, has produced equipment that can be installed on even the smallest USV. Other capabilities that exist on current and developmental USVs that produce essential information to the commander are side scan and dipping sonars, electronic warfare equipment, radars, and communications suites to transmit collected data. Weapons packages, such as torpedoes, guns, and even surface-to-surface missiles are being considered to be deployed on USVs.

Autonomy, the ability for an unmanned vehicle to conduct missions with limited or total absence of operator interaction, is a feature that is in development. In conjunction with autonomy development, the capability for obstacle and collision avoidance is being tested by various engineering corporations. These two capabilities offer multiple benefits. Since the USV is most likely not the only vessel operating in the vicinity and not all obstacles are charted, avoidance controls are required to prevent collisions or running aground without direct operator interaction. Autonomy permits preprogramming a vehicle with mission parameters to include area of operations, communication transmission windows, and maneuvering instructions. Development of higher levels of autonomy may produce vehicles that can automatically divert from the preprogrammed mission based on the detection of acoustic or electronic signals, or visual threat recognition. USVs that have the capacity to operate autonomously will reduce the operator interface load and afford the same operator to simultaneously control more than one vehicle. With the reduced controlling signals, more bandwidth is available for the vehicle to transmit essential visual, electronic or acoustic data back to the control station for further transmission to the operational commander.

DEMONSTRATED UTILITY

USVs do not only exist on the drawing board or at test facilities. USS GETTYSBURG (CG 64) deployed in 2003 with Spartan Scout to the Arabian Gulf with the ENTERPRISE Carrier Strike Group (CSG).[17] Spartan Scout is the product of an Advanced Concept Technology Demonstration under the direction of the Naval Undersea Warfare Center in Newport, RI. Fitted with electro-optical/infrared sensors, a surface search radar, a digital imagery transmission system, and remote control suite, it was evaluated as a force protection system against asymmetric threats with the ability to rapidly establish the plot of possible threatening craft around the CSG and provide real-time observation of maritime interdiction boardings.[18]

In 1997, concerned with the increased potential threat to the physical security of U.S. forces in the Gulf area, COMUSNAVCENT requested USV augmentation of the waterside security forces provided by the deployed Mobile Inshore and Undersea Warfare (MIUW) detachment. In response, the Space and Naval Warfare Systems Command formed and deployed a USV detachment with two SEA OWL Mk II USVs and supporting equipment to the Arabian Gulf from May to August 1997. The detachment was operational in theater only 12 days after receiving tasking. Outfitted with sensor packages of high resolution cameras, starlight cameras, high definition thermal imagers, and side-scan sonar, the detachment conducted and demonstrated capabilities to perform waterside security, port and harbor surveillance, and maritime interdiction operations. Additionally, the detachment demonstrated its versatility and ease of adaptability by operating from multiple platforms to include an Oliver Hazard Perry class frigate (FFG), an Avenger class mine countermeasures ship (MCM), and a Pegasus class MK-V Special Operations Craft/Patrol Boat Fast (PBF).

Of particular note, the USVs demonstrated the ability to execute tasking continuously for 24 hours and conducting harbor surveillance during weather conditions that precluded operations of manned small craft.[19]

The United States is not the only nation pursuing the development and employment of USVs. Various corporations around the world, some in connection with U.S. businesses, are fielding USVs. Elbit Systems Ltd from Israel has leveraged off their extensive experience in the development and operation of UAVs to produce two USVs in the recent years - Stingray in 2005 and Silver Marlin in 2007. Both are equipped with autonomous navigation and positioning capability and sensors to support force protection, mine warfare and intelligence, reconnaissance and surveillance missions. In a joint development effort, BAE Systems, Lockheed Martin and Rafael Armament Development Authority, Ltd. produced Protector in response to emerging terrorist threats against maritime assets.[20] Protector, either a 9-meter or 11-meter remote-controlled USV, is equipped with a "mini-Typhoon" (Mk 49 Mod 0) gun system, cameras, radar and electro-optics.[21] The Singaporean navy currently employs Protectors and has conducted operations in their territorial waters and the Arabian Gulf.[22] Sources say Israel uses Protectors, presumably off the Gaza Strip and near Lebanon, in protecting the nation's coastline from smuggling and terrorism. The Israeli navy neither confirms nor denies the claim, and has stopped commenting on USVs altogether, citing "sensitive issues."[23]

OPERATIONAL ART

The application of creative imagination by commanders and staffs – supported by their skill, knowledge, and experience – to design strategies, campaigns and major operations and organize and employ military forces. Operational art integrates ends, ways, and means across the levels of war.[24]

In addition to the potential for major combat operations at sea, terrorism has significantly increased the nature of the nonmilitary, transnational, and asymmetric threats in the maritime

domain that the United States and its allies and strategic partners must be prepared to counter.[25] The National Strategy for Maritime Security states, "The United States will prevent potential adversaries from attacking the maritime domain or committing unlawful acts there by monitoring and patrolling its maritime borders, maritime approaches and exclusive economic zones, as well as high seas areas of national interest, and by stopping such activities at any stage of development or deployment."[26] To support the National Strategy for Maritime Security, military planners must gather and analyze information on the operational environment, capabilities of current or potential adversaries, and the possible intentions of those adversaries. Without placing personnel into high risk situations or in areas that present navigation hazards to the fleet units, the USV is a capable platform of fulfilling the information gathering mission both above and below the surface. When employed effectively, USVs will complement the current force across the operational factors of time, space and force. The following paragraphs correlate the USV capabilities to the Joint Operational Functions.

Joint Publication 3-0 defines "joint functions" as related capabilities and activities grouped together to help Joint Force Commanders integrate, synchronize, and direct joint operations.[27] Functions common to joint operations at all levels of war fall into six basic groups – command and control, intelligence, fires, movement and maneuver, protection, and sustainment.[28] With creative employment, USVs integrate across all functions.

Command and Control

The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.[29]

Command and Control (C2) encompasses the exercise of authority and direction by a commander over assigned and attached forces in the accomplishment of the mission.[30] The C2 function supports an efficient decision-making process. Enabled by timely Intelligence, Surveillance, and Reconnaissance (ISR), the goal is to provide the ability to make decisions and execute those decisions more rapidly than the adversary. This decreases risk and allows the commander more control over the timing and tempo of operations.[31] The USV provides the commander the persistent source of information required to make the timely decisions while maintaining the forces at a safe distance from high risk situations.

Intelligence

The collection, processing, integration, evaluation, analysis, and interpretation of available information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations.[32]

Understanding the operational environment is fundamental to joint operations. In order for the operational commander to make decisions and direct operational employment of forces to achieve the advantage, sensors and assets must be integrated and synchronized with processing and dissemination systems. UAVs have been fulfilling the sensor role for years, but the majority of operations have been focused inland. Recent developments of UAVs that can be launched and recovered from ships have assisted the maritime commander by extending the sensor range of the force while keeping helicopter crews safe. The collection of intelligence is potentially a primary role for USVs along coastlines, in and around harbors and straits, and in riverine environments. USVs provide more flexibility for the operational commander to obtain a real-time picture of the operational area, especially in hostile environments. The sensor packages provide persistent data collection above and below the surface while preventing the exposure of personnel and units to unnecessary endangerment.

Fires

The use of weapon systems to create a specific lethal or nonlethal effect on a target[33]

Policy, guidance, and planning for the employment of operational and strategic fires is primarily a joint function.[34] Familiarity with UAVs has matured to the extent that a Predator UAV was used by the CIA to eliminate a terrorist in Yemen with a Maverick strike.[35] The use of armed UAVs has increased to include the arming of RQ-5 Hunters with Viper Strike precision-guided munitions.[36] To further increase the hunter-killer capability of UAVs, testing has recently been conducted to validate the deployment of GPS-guided weapons from MQ-9 Reapers.[37] Various weapon systems to include guns, missiles and torpedoes are being considered for USVs but remain as proposals and considerations. The Army has also investigated sources for remote weapons stations to use on USVs in support of service operations near the shore, in ports, and on rivers.[38] It is understandable if USVs enter the fleet without a lethal weapons capability, but just as UAVs have graduated to the position of a lethal tool, it would be anticipated that USVs will eventually reach that plateau. But USVs are capable of supporting the fires function through the use of electro-optical cameras and laser designators to provide targeting information to the shooter. The study of the associated rules of engagement and Law of the Sea concerns need to be addressed, but are outside the scope of this paper.

All fires do not include the delivery of ammunition and warheads. Nonlethal fires include information operations capabilities which focus on military actions involving the use of electromagnetic and directed energy to attack the enemy.[39] Sound is a powerful nonlethal weapon. In 2005, a cruise ship attacked by pirates off the Somali coast used a sonic device to ward off its assailants.[40] A USV configured with this same technology employed by the cruise ship, which is also employed by naval vessels, can provide a stand-off defensive option to deter and defeat small boat terrorist attacks. Additionally, some USVs are equipped

with announcing systems that can broadcast verbal warnings to suspect vessels. With future developments, USVs will have the capability to employ electronic warfare tactics, such as jamming, which can be utilized for missions such as leading a force into an amphibious assault or through a defended choke point.

Movement and Maneuver

Movement – Moving or deploying forces into an operational area
Maneuver - Employment of forces in the operational area through movement in combination with fires to achieve a position of advantage in respect to the enemy in order to accomplish the mission.[41]

Mines have sunk or damaged more ships than any other means of attack since World War II.[42] In enclosed or semi-enclosed seas, such as the Arabian Gulf and Yellow Sea, as well as within the world's most important choke points, such as the Strait of Hormuz, Strait of Malacca, and the Bab el-Mandeb Strait, mines are a significant threat.[43] If not located and neutralized, mines can drastically hinder or even block access to the region by both military forces and civilian merchant traffic. USVs can be employed to secure the lines of communication to allow for the movement of forces into an area. Through the use of radars, electro-optical sensors, and sonar, maritime domain awareness can be developed beyond of the ranges of traditional force sensors. The detection and removal of obstacles by USVs ahead of an advancing force reduces any delays and shifts the momentum and advantage to friendly forces without the necessity to deploy additional forces (i.e MCM) to the region. With follow-on persistent USV presence, the force will maintain the freedom of movement in the maritime environment as well as along the sea-shore interface. Placing USVs in the lead for these high risk missions keeps personnel safe and relieves multi-mission surface combatants of this tasking so they are available to take advantageous positions for potential fires support.

Protection

Preservation of the effectiveness and survivability of mission-related military and nonmilitary personnel, equipment, facilities, information, and infrastructure deployed or located within or outside the boundaries of a given operational area.[44]

Active defensive measures that protect the joint force, its information, its bases, necessary infrastructure, and lines of communication from an adversary's attack is a primary way the protection function focuses on conserving the joint force's fighting potential.[45] USVs provide the capability to establish force protection measures in high risk situations while not placing personnel in harm's way. As demonstrated by the USV detachment deployment in 1997 to the Arabian Gulf, the capability to support the protection of forces or port facilities can be rapidly deployed and operational in theater. The USV can establish surveillance of security zones while overcoming the limitations of manned craft when considering time and weather restrictions.

Protection is not only a function to be exercised while in port. Detection of an adversary either above or below the surface at ranges outside of their weapon ranges places them in a disadvantageous position while providing friendly forces time to react to the threat. Surveillance areas and protective barriers established using USVs enables the commander the freedom of maneuver within the area to employ multi-mission surface combatants for higher tasking such as ballistic missile defense or strike operations.

Sustainment

The provision of logistics and personnel services required to maintain and prolong operations until successful mission accomplishment.[46]

The focus of sustainment in joint operations is to provide the commander with the means to enable freedom of action and endurance and extend operational reach. Effective sustainment determines the depth to which the joint force can conduct decisive operations; allowing the commander to seize, retain and exploit the initiative.[47] Maintaining the security

of shipping lanes and the sea ports of debarkation are critical to the flow of logistics into a region of operations. The capabilities discussed for the employment of USVs in the protection function, which will lead to the freedom of movement into and maneuver within the region, will contribute to the ability to sustain the forces. In a more direct role, albeit a small role based on capacity, a USV could be utilized to make logistics runs from sea to forces ashore. Concepts of operation are also in consideration for the application of small and covert USVs (i.e. X-Class) to deliver supplies to special operations forces through riverine systems.

RECOMMENDATIONS

The responsibility to include USVs in doctrine, tactics and global force management is upon the leadership now. General Dynamics Robotic Systems delivered the first 11-meter Fleet Class Anti-Submarine Warfare USV to the U.S. Navy on May 2, 2008 as part of the Littoral Combat Ship mission package.[48] With technological advancements routinely outpacing the development of tactics and doctrine, the only way to avoid underutilizing an asset at introduction is to fully analyze the capabilities, study lessons learned from evaluation testing, and creatively determine its position in operational employment.

Current control functionality for USVs is a single station, either on a ship or shore station, which also receives the data collected from the vehicle. A USV's utility would be greatly enhanced when data transmission can be received at multiple user locations vice a single node. A USV transmitting near-real time imagery or acoustic data to multiple collection/analysis sites decreases information lag time and increases overall situational awareness for planning and making decisions.

As demonstrated by the USV detachment that operated in the Arabian Gulf at the request of COMUSNAVCENT in 1997, a detachment can deploy and be operational in theater rapidly. More investigation needs to be conducted on the feasibility of standard integration of USVs into Maritime Expeditionary Security Groups, Riverine Groups, and other small boat detachments to support emergent tasking.

An additional concept that should be investigated is not permanently installing USVs on surface combatants, but establishing a squadron and detachment structure similar to helicopter commands. Embarking helicopter detachments on air capable ships has become second nature to both aviators and surface warriors. The same can be accomplished with USV detachments. An advantage to this structure is eliminating specialized secondary training requirements in maintenance and operation of the USV and supporting equipment for the ship's crew.

CONCLUSIONS

The threats of potential nation state adversaries, terrorists, and pirates in the maritime domain are a significant concern for the military and civilian merchants alike. Although the U.S. Navy is comprised of high-tech multi-mission platforms operated by well trained and talented sailors, the area to cover is too immense for the Navy to be everywhere at all times to maintain security. The Navy has operated USVs with success in limited roles in the Arabian Gulf, as have other countries. With the proper exposure and awareness of their capabilities, USVs will be the platform of choice to conduct the dull, dirty, and dangerous missions.

Skeptics may criticize the amount of time, effort and money invested in further development of unmanned vehicles when current force structure supports the missions USVs

would undertake. Realistically, the force is not significantly increasing while the requirement to establish and maintain maritime security is growing exponentially. The importance of USVs is gaining both momentum and credibility, particularly, when riverine and littoral missions are being considered. This has occurred because when due consideration is given to the attack on COLE, the attempted hijackings and attacks of vessels close to the Basra oil terminal, USVs are ideally suited to play a significant protection and surveillance role.[49] If the option is available to either task a manned craft, whether it is a surface combatant or a small craft, to a high risk mission that could be accomplished by a USV, the decision is clear – don't place the personnel at risk.

Although a number of the employment options and techniques discussed above are tactical, it is the operational commander's responsibility to consider these options into the planning process and courses of actions in order to request and allocate the most effective forces for the missions. As USVs become more common place in the operating area, they will be a remarkable force multiplier and provide the operational commander a versatile platform for conducting a variety of missions to augment the forces in gaining advantage over the adversaries.

NOTES

[1] Office of the Secretary of Defense, *Unmanned Systems Roadmap (2007-2032)*, (Washington, DC: Office of the Secretary of Defense, 10 December 2007), i.

[2] General Accounting Office, *Unmanned Aerial Vehicles: Major Management Issues Facing DOD's Development and Fielding Efforts*, GAO-04-530T (Washington, DC: 17 March 2005), 3, http://www.gao.gov/new.items/d04530t.pdf/ (accessed 6 September 2008).

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