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Surviving the swarm: navies eye new counters to the FIAC threat

The threat from multiple manoeuvring fast craft operating in the close confines of the littoral environment has been a focus of attention for many western navies in recent years. *Richard Scott* examines the various ways and means in which this asymmetric risk is being addressed

The asymmetric surface threat is by no means a new phenomenon. In 1945, the US Pacific fleet lost a number of ships to Japanese Shinyo-type 'explosive motorboats' - vessels which were, to all intents and purposes, high-speed suicide craft. In the mid-1980s, the Iranian Revolutionary Guards Corps Navy (IRGCN) began to field 'weaponised' Boghammar speedboats. Indeed, the IRGCN's unconventional use of these craft in the Gulf's 'tanker wars' of the late 1980s can in hindsight be seen as marking the birth of the fast inshore attack craft (FIAC) in the modern era.

However, there is no doubt that the asymmetric surface threat has taken on increased significance over the past decade, with the IRGCN still recognised as the foremost - though by no means only - practitioner of small boat 'swarm' tactics that combine speed, mass, co-ordinated manoeuvre, low radar signature, and concealment. Moreover, the IRGCN has continued to invest significantly in FIAC platforms and weapons and to exercise this capability regularly in wargames in the Gulf. Such exercises have been used by Tehran as a very public means of backing up its rhetoric over closing, or at least obstructing, the Strait of Hormuz in response to the threat of international trade sanctions or other issues.

Swarming threat

In common with many other platform typologies today, determining what is, or what is not, a FIAC is a challenge. For example, in 2005 the UK's Defence Science and Technology Laboratory released a report that categorised FIACs into three subtypes: Type 1 were jet-ski or Boston Whaler craft carrying rocket-propelled grenades (RPGs) credited with a firing range of between 300 m and 500 m; Type 2 were Boghammar or similar fast craft, fitted with unguided multiple launch bombardment rockets, or a larger anti-tank guided weapon with a launch range of a few kilometres; and Type 3 were in effect small fast attack craft (FACs) with small anti-ship missiles or torpedoes, some organic sensors, a degree of command and control, and an endurance of several days.

Today, the UK Royal Navy (RN) tends to take a narrower view, generally characterising the FIAC as a craft of up to 15 m in length, with no organic sensors, limited endurance/sustainability, and carrying a manually directed weapon payload (typically RPGs, unguided rockets, and/or machine guns). Such craft rely on third party sources to fix and close their target, with the limited range and effect of their weapons necessitating close-quarters engagement.

Vessels equipped with guided weapons, such as lightweight anti-ship missiles or torpedoes, are promoted into the realm of the FAC. These are generally larger, self-sustaining platforms with extended endurance and organic situational awareness.

Suicide craft also fall into the separate category of waterborne improvised explosive devices (WBIEDs). In this case, the craft functions as a means of weapon delivery and as the weapon itself.

Of course, while the FIAC by itself may be limited in terms of reach and effect, it is its ability to integrate as part of a larger force - which may also include FACs and WBIEDs - that causes particular concern. Interleaving these assets - and their ability to fire weapons from longer range, penetrate very close-in at high speed, bring a level of command, control and cueing support, and the possibility of split axis attacks - with FIACs creates the potential to multiply the 'swarm' threat many times. Such is the nature of the tactical development undertaken by the IRGCN in recent years.

Swarm front: an Iranian FIAC swarm attacks a decommissioned landing ship during a live-fire exercise. (Fars News Agency)

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In 2009, a US Office of Naval Intelligence (ONI) report titled 'Iran's Naval Forces - From Guerrilla Warfare to a Modern Naval Strategy' articulated how the IRCGN seeks to achieve tactical success, noting that "modern small boats are capable of high speed, have very shallow drafts, can be difficult to detect because of their small size, and may not be positively identified even when detected". This leaves them "well suited for conducting hit-and-run style attacks".

The ONI report continued by pointing out that FIACs attempt to use geography to their advantage, in engaging targets that are inherently constrained in terms of manoeuvrability. Furthermore, FIACs tend to operate in groups, or 'swarms'. "Operating in groups affords small boats better combat

capabilities through mutual protection, while also increasing their offensive firepower … so they will typically rely on mass and manoeuvre to overwhelm their target, anticipating that some of the small boats will penetrate a ship's defences," it stated.

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Building the picture

One of the biggest issues for maritime commanders is the compilation and maintenance of an accurate surface picture to create a high level of situational awareness. This is inherently difficult in littoral environments routinely described today as congested, cluttered, contested, connected, and constrained.

This complex operational arena plays to the strengths of the FIAC threat and, conversely, presents a multitude of problems for larger surface combatants in theatre. Forces operating close in to shore in shallow and confined waters find their manoeuvre space limited, while at the same time facing increased susceptibility to targeting from sea or shore. Also, the presence of large numbers of non-combatants close-in makes track identification much more complex, and enables potential FIAC threats to hide among the routine, daily traffic.

Detecting and tracking small, fast, surface craft among significant littoral clutter is complicated further still by the electromagnetic and electro-optical (EO) propagation issues. Ducting and refraction effects can significantly degrade radio frequency (RF) and EO/infrared (IR) sensors. The Gulf in particular is renowned for its difficult propagation conditions.

Above all, there is an inherent challenge in being able to determine intent at sufficient range to enable defensive measures to be activated. The potential for miscalculation is a constant risk, a consideration that is factored into rules of engagement (RoE). This risk also mandates regular and rigorous training for command and warfare teams. It is not just a matter of understanding the 'kinetic' aspects of close-in defence. It equally is essential that commanders make sound judgments on intelligence and cueing, the RoE, tasking of assets, planning, manoeuvring, sending out warnings and establishing intent, and, as a last resort, engagement.

The ability of airborne intelligence, surveillance, and reconnaissance (ISR) platforms to find, fix, and continuously track potential threats at range is thus highly valued. Operating at altitude, and thus able to cover a broad swath of sea space, radar-equipped maritime patrol aircraft (MPA), helicopters, or unmanned aircraft systems (UASs) may pick up hundreds of contacts across a wide area. These assets may also be equipped with EO/IR sensors and a full-motion video downlink, to enable contacts to be fixed and identified. Alternatively, they can cue other assets - such as shipborne helicopters and maritime UAS systems - to probe contacts.

The ability of an organic maritime UAS to provide persistent ISR - and, where necessary, targeting support - has already been recognised by a number of navies. Systems such as the Boeing/Insitu ScanEagle have demonstrated a capability to deliver EO/IR feeds for extended periods, helping to identify threats at range.

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Delivering effect

The increasing attention paid to the 'swarming' surface threat in recent years has been accompanied by the development of weapon systems - particularly, shipborne gun systems and air- and surface-launched precision guided weapons - optimised for defensive ASuW. The potential of directed energy weapons is also being explored, with the US Navy (USN) already planning to deploy a high-energy laser prototype in the Gulf in mid-2014 (see Box 1).

The Block 1B upgrade package adds a surface engagement mode for the Phalanx CIWS. (US Navy)

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One solution has been to modify rapid-fire, close-in weapon systems (CIWSs), originally developed to offset anti-ship missile threats, to generate a counter surface threat capability. This course was first followed by the USN and Raytheon Missile Systems, with the Block 1B upgrade to the Phalanx CIWS. The Block 1B implementation, also known as the Phalanx Surface Mode upgrade, introduces a forward-looking IR sensor, automatic acquisition video tracker, improved Ku-band search and track

radars, new local and remote control stations, and an optimised gun barrel set (fixed in a stiffened cluster) for the M6A1 six-barrel 20 mm Gatling gun.

The Royal Netherlands Navy and Thales Nederland are now also adding an EO sensor subsystem to the Goalkeeper CIWS as part of the Instandhouding Goalkeeper upkeep and modernisation programme. This upgrade includes integration of a new EO channel, which, as well as offering more accurate angular resolution against air targets, also improves Goalkeeper's capability against fast and agile surface threats.

Alongside upgrading CIWS systems, the requirement to deliver accurate, controlled fire against small surface targets has largely driven the development of an abundance of remotely operated, stabilised, small-calibre weapon systems. The introduction of such systems - typified by Rafael's Typhoon family (including BAE Systems' license-built Mk 38 Mod 2), the Rheinmetall MLG-27, MSI-Defence Systems' Seahawk line, and Oto Melara's MARLIN-WS - in significant quantities reflects the operational need for a responsive, proportionate, scalable, and precise defensive ASuW capability.

Controlled from the bridge or from a below-decks operator console, and integrating target indication information from on-mount or remote EO sensors with integral ballistics computing, such weapons give commanders the ability to reliably detect, track, identify, and, if necessary, engage threats from a protected space.

What is now becoming apparent is the growing interest from manufacturers and users alike in further developing these stabilised weapon platforms by adding a guided ASuW weapons capability. Other players in the market are proposing the development of low-cost, stand alone, surface-launched solutions to increase the defensive envelope against FIAC-type threats (see Box 2).

The emergence of 'smart' medium-calibre ammunition is also noteworthy. Programmable fuzes - such as the 3P fuze developed by BAE Systems Bofors for its 57 mm gun line - enable ammunition to be programmed at the point of launch so as to optimise effect against specific target sets. The development of guided rounds - exemplified by Oto Melara's emerging Vulcano 76 sub-calibre projectile - offers the prospect of extended range and precision accuracy (enabled by the combination of GPS/inertial mid-course correction coupled to IR terminal guidance).

The evolution of the asymmetric surface threat also has put shipborne helicopters at the forefront of force protection and defensive ASuW measures in high-threat operational theatres. One response adopted by many navies has been to 'up-gun' their helicopters with the installation of 0.5-cal heavy machine guns (HMGs). HMGs provide a cost-effective and flexible capability, not least because they can offer a graduated response in which shots across the bow may well prove to be a sufficient deterrent.

However, an HMG's relatively short range could leave the host aircraft vulnerable to counter-fire, such as from IR-guided man-portable air defence systems (MANPADS). Thus, there is a growing interest in the development of new guided weapon solutions which combine low cost, proportionality, and precision, while at the same time offering an ability to 'stand-off' outside MANPADS range.

The US Naval Air Systems Command (NAVAIR) previously identified a need for a system, or systems, which can deliver the capability to rapidly and simultaneously engage large numbers of small, fast-

moving, surface targets along multiple axes, in clear, obscured, and adverse weather conditions as well as at tactically significant ranges. To date, NAVAIR has sponsored two demonstration efforts.

The first of these was the Low-cost Guided Imaging Rocket (LOGIR) concept, taken through early development in partnership with the Republic of Korea. LOGIR was conceived to provide a 'fire and forget' capability against FIACs by marrying a low-cost imaging infrared (IIR) precision guidance section to existing 2.75-inch Hydra 70 unguided rockets (carrying the M151 warhead). Central to LOGIR is a Low-Cost Imaging Terminal Seeker (LCITS) package funded as part of the Office of Naval Research's (ONR's) Future Naval Capabilities programme. LCITS comprises three main subsystems: a targeting integration system aboard a host helicopter platform; a digital smart launcher; and the IIR seeker guided rocket.

The Republic of Korea joined the LOGIR programme in 2007 as co-development partner. Its participation, involving the Agency for Defense Development and the Hanwha Corporation, has helped to improve the LOGIR system's aerodynamic performance and electronic assembly hardware design, to lower the overall design cost.

In 2010, a series of successful tests progressively demonstrated critical elements of the LOGIR concept. In a demonstration performed at the Naval Air Warfare Center Weapons Division (NAWCWD) Point Mugu sea range in May 2010, an LCITS-equipped AH-1W Cobra helicopter targeted and fired a rocket against a manoeuvring unmanned small boat. The test demonstrated the capability of the guidance package against FIAC-type surface targets, and also marked the successful conclusion of the LCITS programme, paving the way for the LOGIR weapon to transition to the Medusa Joint Capability Technology Demonstration (JCTD) phase. The USN went on to demonstrate LOGIR from an MH-60 helicopter during the JCTD.

However, the USN is now focused on integrating the low-cost, precision-guided, 2.75-inch rocket-based Advanced Precision Kill Weapon System (APKWS) on board MH-60R and MH-60S maritime helicopters as a rapid deployment capability, an accelerated effort that followed tests conducted in early 2012. These tests demonstrated the capability of APKWS in countering small boat threats.

Developed and manufactured by BAE Systems, APKWS II integrates a low-cost Distributed Aperture Semi-Active Laser Seeker (DASALS) guidance section with existing Hydra 70 rocket motors and warheads, to deliver precision and low collateral effects against soft and lightly armoured targets. Designed as a 'plug and play' kit, the DASALS unit is installed between the Hydra 70 warhead and its rocket motor. The seeker aperture is divided into four elements, with each element placed on the four wings of the guidance section to provide an integrated navigation solution.

APKWS achieved initial operating capability on US Marine Corps (USMC) AH-1W and UH-1Y helicopters in March 2012. Funded efforts are also under way to integrate it on US Air Force A-10 Thunderbolt II and USMC AV-8B Harrier fixed-wing aircraft, as well as the USN's MQ-8B Fire Scout UAV.

The USN now plans to introduce APKWS and the associated Digital Rocket Launcher (DRL) on its MH-60R and MH-60S helicopters (the DRL provides the means for APKWS to interface with the aircraft systems). The USN is aiming to achieve an early operating capability on the MH-60S in fiscal year 2014.

Initial sea-based test firings of APKWS were conducted from the MH-60 in January 2012. Ten live-fire tests were performed against stationary and moving surface targets on the Point Mugu range, with both high explosive and flechette warheads tested.

The USN is also planning to field a sea-based, 'weaponised' UAS using APKWS. In June 2013, it conducted successful operational testing of APKWS aboard an MQ-8B UAS at China Lake, California, in response to a US Naval Forces Central Command request for a Rapid Deployment Capability. MQ-8B operators successfully launched 12 APKWS rockets, with 11 rockets hitting the designated targets (the single miss was attributed to an APKWS guidance system malfunction).

Under its Future Anti-Surface Guided Weapon (Light) (FASGW[L]) programme, intended for deployment on the RN's new Wildcat HMA.2 helicopter, the UK is also looking at low-cost, guided munition options, in the shape of the Thales UK Lightweight Multi-role Missile (LMM), to counter the FIAC threat. LMM is a laser-guided missile designed to engage a wide range of air, land, and sea targets. The missile variant adopted for FASGW(L) will use laser-beam riding guidance, which Thales argues is the optimum solution given the scintillation and dispersion problems encountered in the maritime environment.

The laser proximity fuze, using simple low-cost gate technology set at the point of launch, is designed to ensure that the missile can successfully engage very-low metal, semi-solid targets, such as rigid inflatables, which many rockets can often pass through without detonating.

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LASER WEAPONS TAKE AIM AT SURFACE THREATS In April 2013, the US Navy (USN) announced its intention to deploy a prototype Laser Weapon System (LaWS) on board the Afloat Forward Staging Base (Interim) USS *Ponce* in the Gulf, a move that heralds the first known operational deployment of a high-energy laser weapon anywhere in the world.

Meanwhile, the US Office of Naval Research (ONR) is looking to its Solid-State Laser - Technology Maturation (SSL-TM) programme to lay the foundations for follow-on prototypes for installation and test on board USN surface combatants. Another research thread is examining the viability of an airborne fibre laser suitable for installation on an MH-60 helicopter.

The USN intends to install and deploy the LaWS demonstrator weapon - designated AN/SEQ-3 (XN-1) - on board *Ponce* in the middle of 2014. Final shore tests are due to conclude at the Naval Surface Warfare Center Dahlgren Division range by the end of March.

LaWS is a technology demonstrator built 'in-house' by the Naval Sea Systems Command (NAVSEA). Under development since 2007, the system integrates six 5.4 kW commercial fibre SSLs with a beam combiner developed by the Naval Research Laboratory, generating a total power output of 32.4 kW. The beam director is fitted on an L-3 Brashear KINETO K433 tracking mount.

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STRIKING OUT AGAINST THE SMALL BOAT THREAT Rival guided missile houses MBDA and Raytheon Missile Systems are addressing emergent operational requirements for surface-launched precision

engagement against FIAC swarms. What is notable is that the two companies are coming at the defensive ASuW problem from very different standpoints.

MBDA has worked under private venture funding to adapt the existing air-launched Brimstone missile under the product name Brimstone Sea Spear. This surface-launched variant has been designed to leverage the all-weather millimetre wave (mmW) seeker of the 'fire and forget' Brimstone for precision engagement of FIACs and other small surface threats. In addition, MBDA has conceptualised a range of low-footprint, deck-mounted, launcher options, from single to six-pack configurations, to enable flexible installation on a wide range of vessel types.

According to MBDA, Brimstone Sea Spear offers a capability to engage multiple targets simultaneously, using inertial mid-course navigation followed by mmW seeker lock-on. Key attributes include an extended stand-off range, and a large (16 kg) tandem shaped-charge warhead.

In a May 2013 company-funded trial, MBDA demonstrated a surface-to-surface salvo engagement of multiple FIAC threats with a single button push. Three Brimstone missiles were launched in less than a second against a simulated formation attack involving five representative FIACs. The three missiles independently acquired and engaged their respective targets at a distance between 4 km and 5 km (constrained by range safety). Direct hits resulted in extensive damage to the three leading vessels, one of which was moving at around 20 kt. The missiles were launched from a surface trials platform using a Brimstone triple rail launcher in Sea State 3 conditions.

Meanwhile, Raytheon is pursuing two separate lines of development. The first is being pursued in partnership with Chemring Countermeasures, and leverages Chemring's Centurion multirole launcher. Originally conceived to deliver accurate placement of advanced soft-kill countermeasures for anti-ship missile defence, the Centurion launcher is now also being offered as a multirole system capable of deploying a wide range of effectors.

In February 2013, Raytheon and Chemring announced plans to develop a low-cost defensive ASuW capability, specifically intended to counter FIACs, designed for ships ranging in size from small patrol boats to large combatants. This capability will integrate Centurion with a variety of Raytheon missiles, including Javelin and Griffin. A first proof-of-concept missile firing was successfully conducted in October 2013 using a Javelin missile. According to Raytheon, the test proved missile/launcher hardware interfaces and physical characteristics at launch (including stresses and efflux/ablative effects).

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