Swarming

Application of lessons from World War II patrol torpedo boats

by Maj Scott Caton

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Nations with sophisticated militaries are capable of detecting and engaging adversaries utilizing large ships and aircraft with advanced air and surface radars, sensors, and precision-strike weapons.[1] The United States, like other nations, uses distance to increase survivability while investing in more powerful radars, sensors, and weapons to maintain lethality—a seemingly endless cycle. This problem only worsens in the future. In response, the U.S. military is exploring "stand-in" and "insider" asymmetric capabilities and concepts—such as swarming—that can operate within enemy threat rings, the anti-access/area denial (A2/AD) environment. Swarming is the systematic and simultaneous temporary massing of dispersed and connected forces and fires against an adversary from all directions. The objective is to destroy adversary physical and psychological strength and increase friendly force survivability.[2] Operational and tactical swarming of the Marine Corps and Naval force and fires is essentially articulated in the Distributed Maritime Operations, Littoral Operations in a Contested Environment, and Expeditionary Advanced Base Operations concepts. It is critical to examine the concept of swarming and evaluate a historical example to inform the debate over the above concepts and tasks within the *38th Commandant's Planning Guidance* to create a Naval Expeditionary Force.

During World War II, allied Patrol Torpedo (PT) boats utilized swarming tactics at night with great effect against axis power coastal supply ships, cruisers, and destroyers.[3] While submarines likely had an even more significant impact, they did not employ swarming tactics in the same way at the PT boats. Nor did they utilize radars as PT boats did, which created superior situational awareness for the group of PT boats. Submarines were very effective in countering the German and Japanese Navy and continue to be critical in future Naval campaigns. With the incorporation of radars—designed primarily to detect surface ships and occasionally some aircraft—and radios, PT boats were able to detect adversary forces and coordinate dispersed attacks by employing swarming tactics.[4] Radars and radios on PT boats provided superior situational awareness that facilitated improved survivability and coordination, enabling the swarming of forces and fires on adversaries and enhancing the capabilities of larger, more conventional military forces. The lessons of World War II PT boats can be applied to help the Marine Corps conceptualize future combat operations and better support the future Naval Expeditionary Force.

The reality is that swarming is not a dramatically new way of warfighting for the Marine Corps. Today's iteration is a response to the evolving future operating environment that is defined by complex terrain, technology proliferation, information warfare, electronic signatures, and an increasingly contested maritime domain.[5] Swarming is in line with *MCDP 1, Warfighting*, as it abstractly can be found in maneuver warfare.[6] *MCDP 1* states that the Marine Corps doctrine is

> rapid, flexible, and opportunistic maneuver … action to generate and exploit some kind of advantage over the enemy … generate a faster operating tempo than the enemy to gain a temporal advantage … bypass these defenses in order to penetrate the enemy system and tear it apart … shattering his moral, mental, and physical cohesion.[7]

Swarming supports all of those things by combining fires, maneuver, and information in a unique way.

According to multiple RAND Corporation reports on swarming, there are five core variables to successful swarming: superior situational awareness, elusiveness, standoff, envelopment/encirclement (multi-directional attacks), and simultaneity.[8] Out of those five, superior situational awareness, elusiveness, and standoff are deemed to be the most important. This enables survivability while retaining lethality. Superior mobility (speed) and concealment (prevent detection) contribute to elusiveness, which is the ability to avoid the enemy until fires and forces decide to converge on the adversary, creating simultaneity, from multiple directions. Standoff relates to the ability to inflict damage on the enemy while using distance to increase survivability. Superior situational awareness enables superior decision making, enabling coordination, and the simultaneous convergence of forces and fires to achieve destruction criteria and surprise.

Based on the above five core variables, there are two requirements for successful swarming. First, swarms must have

many small dispersed units capable of quickly and effectively coordinating and striking an adversary from multiple distances and directions. Second, units must serve as sensors and communicators to generate situational awareness and simultaneity.[9] Figure 1 shows the influence between important variables.[10] A robust network of sensors, sharers, shooters, and deceivers are required to stimulate and collect on adversary forces and coordinate attacks when desired. To accomplish this, commanders must not let their access to greater situational awareness lead to centralized command and control (C2); they must intervene sparingly and move resource that enable self-organization and rapid action. Commanders must reflect on their role in a dispersed and decentralized battlefield. Is it to command and control every aspect of battle, or is to provide clear commanders guidance and tasking and then ensure that subordinates have the resources and information they need? Imagine sensor and sharer nodes that connected various types of shooter and sustainer nodes that have access to superior situational awareness and given greater autonomy. Swarming requires a resilient command, control, communications, computers, and intelligence system. The overall objective of swarming is to improve friendly survivability and weapons effectiveness to defeat the enemy where they are weak over time in a series of smaller victories, adding up to an operational and ultimately strategic victory.[11]

U.S. PT boats belonged to one of the 47 U.S. Navy Motor Torpedo Boat (MTB) Squadrons formed during World War II. Each squadron consisted of ten to fifteen PT boats that typically operated in divisions of three.[12] The British similarly developed Coastal Forces, which utilized their own PT boat variants. British PT boats were defined by their primary weapons capabilities, either a Motor Torpedo Boat or Motor Gun Boat (MGB). The British did not combine both capabilities until 1942, with the introduction of the Fairmile D boats MTB.[13]

PT boats were designed to be fast, heavily armed, lightly armored, and maneuverable while being relatively low

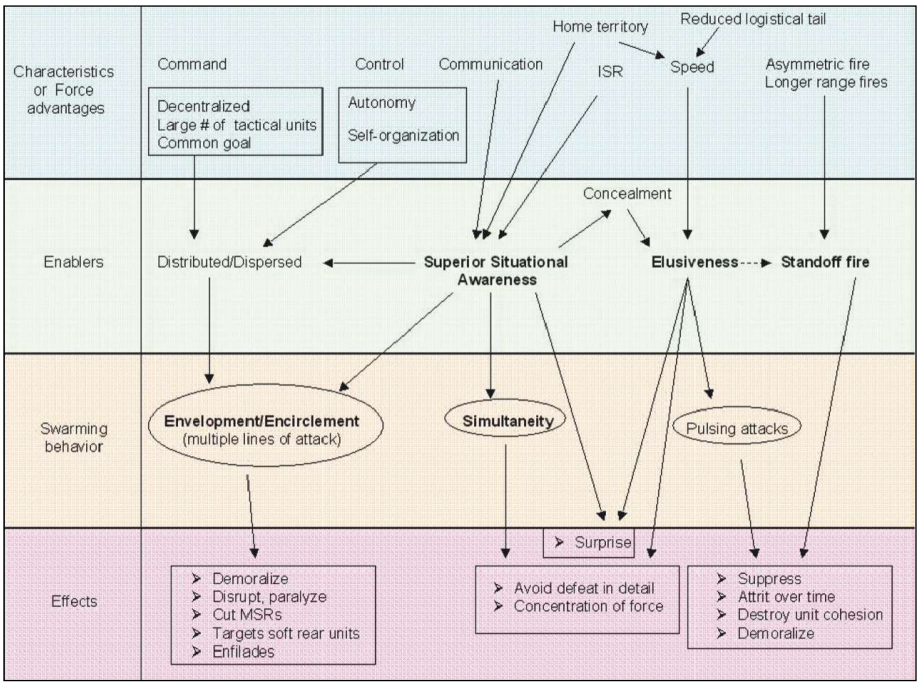

Figure 1.

cost compared to other Navy ships. They had a low profile, could function in shallow waters, and operated at night to avoid detection and being hit by enemy fire while within effective torpedo range. Night time operations reduced the likelihood that PT boats would be visibly detected. They also took advantage of the relatively low performance of enemy radars and the fact that they were not as prolific as today.

The primary mission of U.S. PT boats was to attack surface ships; however, they were also capable of attacking submarines, rescuing vessels, escorting other ships, laying mines, and supporting commando operations.[14] Additionally, PT boats rescued downed pilots and scouted and screened for larger ships.[15] They carried torpedoes, machine guns, and depth charges. Their small size, speed, and maneuverability—combined with their ability to detect ships at night and employ smoke—made them perfect for conducting surprise ambushes.[16] They mostly targeted supply and support ships, light cruisers, and light destroyers.[17] PT boats operated from distributed advanced naval bases, in groups near the coasts, and utilized radars and radios to locate, converge, and attack adversaries—quickly leaving to avoid a sustained engagement. [18]

The tactics employed were similar to what a fighter direction officer would use in the British Royal Air Force to control aircraft swarms against German Air Force aircraft over Great Britain.[19] Coastal radars, larger ship radars, or PT boat radars were used to direct other PT boats. American and British PT boats attacked ships with heavy machine guns and torpedoes (their standoff ship killing weapon), defended themselves from low flying aircraft, and used smoke to obscure their egress.[20] The larger lesson is that surface radars and radios were utilized to direct PT boats, and once engaged their collective situational awareness allowed smaller formations to conduct reattacks from various directions as part of a larger swarm. While not all cases involved larger numbers of PT boats, the general tactics and use of technology remained the same.

Larger naval ships were highly capable of destroying other similar ships but had difficulty operating in the shallower coastal waters and targeting small boats. They were also readily detectable by enemy forces. Enemy supply ships avoided deceive engagements by moving along the coasts with protection from smaller escort ships and shorebased weapons. PT boats operated where larger Navy ships could not and inflicted tremen-

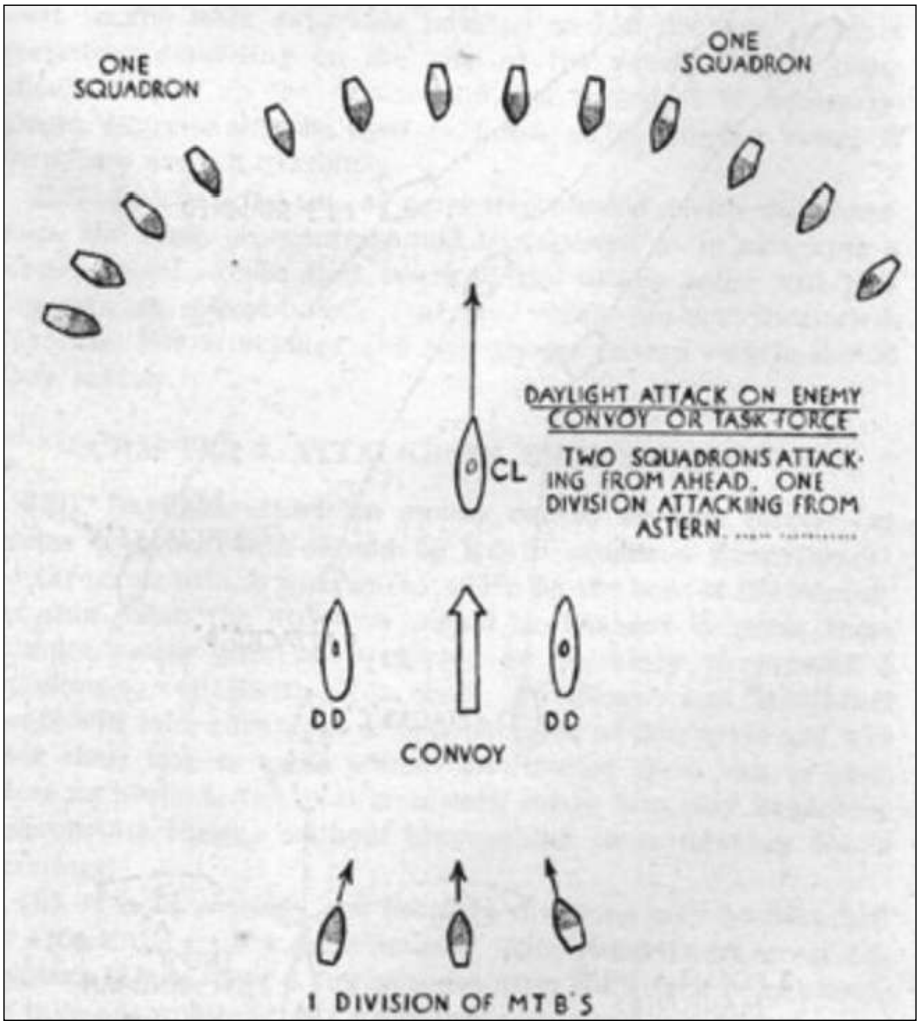

Illustration.

dous damage on German and Japanese supply trains. Early during World War II, air and surface surveillance and targeting radars were developed for use on land and on large navy ships. By the mid-1940s, similar capabilities had made their way to PT boats.

Surface and air surveillance radars and radios on PT boats provided superior situational awareness that facilitated improved elusiveness, standoff, encirclement, and simultaneity. They enabled the swarming of forces and fires on adversaries and enhanced the capabilities of larger more conventional naval military forces. World War II PT boats exercised sea control in the littorals.

During the interwar period, radars made huge technological advancements but remained large and heavy, which presented one of the biggest obstacles for adoption on PT boats. For the British, surface radars were first added to the MTBs and MGB in 1941, with their most advanced version (Type 291U) added between 1942 and 1943. The Type 291U was able to provide aircraft warning and navigation in the daytime as well as surface warning and limited torpedo control at night.[21]

All U.S. PT boats, in contrast, came equipped with the 10cm type "SO" radar with a Plan Position Indicator (PPI) display and power-rotation by 1943, which were superior to the British radars.[22] Later, newer "SJ" radars were fitted on new PT boats while electronic friend-or-foe identification devices were also added towards the end of World War II.[23] Both U.S. radars were 3,000 MHz with 50kw pulse surface search Raytheon radars capable of detecting ships out to 25 nautical miles.[24] The U.S. SO radars with PPI displays allowed PT boats to not only find adversary ships but also more accurately and quickly vector boats.[25]

Radars and radios provided U.S. and British PT boats with the ability to locate, converge, and attack adversaries.[26] PT boats utilized an AM VHF radio that transmitted between 1.5 and 12 MHz frequencies, which provided them with a long-range communications capability up to 70 miles on a good day.[27] After identifying adversary ships, PT boats would coordinate multi-direction pulsing attacks against cruisers and destroyers or would form a column and engage the broadside of barges that operated near the coasts.[28] Radio direction finders were utilized in conjunction with radars to help locate other boats at night, as it was difficult to see and coordinate in the dark.[29]

PT boats would often move in a mass and then break up before the final approach on the adversary. One tactic often involved the combining MGB feint attack with multi-directional striking blows from the MTBs.[30] The following two historical events depict the usefulness of surface radars and radios in coordinating PT boat swarming attacks.

On the nights of 24 and 25 April 1944, a combined force of three British Landing Craft Gunboats, three MGBs, three MTBs, and seven U.S. PT boats departed Bastia, Corsica, to attack German supply convoys off the coast of Italy near Elba, Capraia island, and the Vada Rocks.[31] The boats left at different times because of the different speeds and courses, planning to converging within their operating area near the Vada Rocks.[32]

Once en route, Commander Robert Allan of the United Kingdom's Royal Navy Reserve provided vectors to the other ships from the U.S. PT boat.[33] In doing so, he was able to set up ambush positions from which to attack two convoys of German F-lighter barges, tugs, and trawlers pulling barges from multiple directions. Over the course of two nights, the combined force sunk five barges, one tug, and one German torpedo boat, which hit its mine during the engagement.[34] Given the weakness

of British MTB/MBG radars, the British often utilized Coastal Forces control ships, which were destroyers and frigates with much more capable radars, and shorebased coastal radars to vector PT boats to swarm the adversary.[35]

One of the best examples of U.S. Navy PT Boat swarming utilizing radars occurred on 24 October 1944 when the boats ambushed the Japanese Navy's approaching southern force led by Vice Admiral Shoji Nishimura at the Surigao Strait in the Philippines during the Battle of Leyte Gulf. The day prior, fifteen PT boats were forward positioned at Liloan on Panaon Island, at the entrance to the Surigao Straight.[36] The fifteen PT boats, five divisions of three ships each, were deployed in the eastern portion of the Mindanao Sea.[37] Each division served as a forward scout (sensors and communicators) for their assigned sector and helped to develop superior situational awareness for the rest of the Navy. They then were given mission-type orders to attack as divisions to break up the cohesion of the Japanese force, to not become decisively engaged, and report the location of southerly approaching adversary forces.

Meanwhile, during the day of 24 October, 24 PT boats operating as 8 divisions were deployed along the western and eastern coasts of the straight to report on enemy ship positions and help degrade their capability, softening them for the final battle in the Leyte Gulf.[38] At approximately 2215, PT boat 131 detected multiple radar contacts south of the strait and passed a report of visual contact, but it could not raise anybody on the radio.[39] Throughout the night and morning, as the battle raged, PT boats reported enemy ship locations, conducted pulsing attacks from each side of the strait, and sowed confusion in the Japanese southern force. The PT boats effectively utilized their radars and radios to navigate and coordinate swarming attacks against the Japanese Navy as well as provide situational awareness to the rest of the U.S. 7th fleet lying in ambush.

The use of radars alone was not the only novel characteristic of PT boat tactics. PT boats combined onboard and offboard radars and their unique boat designs to remain elusive and achieve surprise. Boat and shorebased radars and radios provided them with superior situational awareness, allowing them to encircle adversaries and prepare stealthily for a multidirectional simultaneous attack. PT boats had to slip into the threat rings of many adversary ships stealthily to utilize their primary stand-off weapon: the torpedo. PT boats operated best in the littorals, where the coasts and islands provided locations to hide and from which to search for the adversary. The use of Coastal Force Control Ships and shorebased coastal radar and radios provided extended surface surveillance capabilities beyond that found on PT boats. PT boats demonstrated that distributed elusive forces with superior situational awareness can surprise the enemy and engage with a combination of close-in and standoff fires with destructive effect.

A lesson from the use of PT boats is that units do not necessarily need to be the complete package of sensor, sharer, and shooters. Nor is it to argue that the Marine Corps should adopt PT boats; rather, it is the overall lesson on swarming. A PT boat today that is a complete package would likely be a vulnerable target. However, the way they worked together and utilized the full range of their capabilities certainly provides important lessons to the modern military. It is the networked collective that provides effects that are far beyond that of the a single highly capable and large piece of equipment. Elusive dispersed forces with superior situational awareness and standoff weapons are capable of operating within an adversary WEZ and inflicting superior damage.

Radars do not necessarily have to be with the main force to conduct attacks, but superior situational awareness does facilitate swarming forces and fires to effectively engage the adversary. Sensors and fires can be spread out on the battlefield and do not need to always be co-located with maneuvering swarming forces as long as they are communicating and contributing to situational awareness. Unmanned surface and air surveillance drones could contribute as part of a network to provide superior situational awareness of enemy and friendly forces, allowing for large distributed force and fires to swarm.

The *38th Commandant's Planning Guidance*, Distributed Maritime Operations, Littoral Operations in a Contested Environment, and Expeditionary Advanced Base Operations suggest forward employing mobile and relatively low-cost air and surface surveillance sensors and C2 capabilities in austere and temporary land and surface locations as integral elements of the fleet/JFMCC operations.[40] Operating from expeditionary locations, these unmanned air and surface surveillance sensors employ in the air, unmanned aerial systems, on land, unmanned ground vehicle, and the surface, unmanned surface vehicle USV. They screen and scout in hostile areas that may be considered too risky for manned critical forces and assets to operate. These scouts, paired with decoys, "impose increased battlespace complexity on the adversary and confound his decision calculus by forcing him to allocate sensors and shooters against a wider—and more dispersed—set of threats."[41]

Scouts have historically been utilized to develop superior situational awareness so that commanders at various levels can make timely decisions. Scouts provide reports based on information requirements, which connect to important decisions. For the MAGTF as part of a naval force, it deploys capabilities to win the "scouting competition" to establish a maritime balance sufficient enough to accomplish key missions.[42] Employing superior scouting capabilities, which can include manned and unmanned sensors or human reporting, is only part of the competition formula. Equally as significant is the impact of corrupting or providing misleading information and data that compels the enemy to act in a way that is advantageous to friendly forces. For forces to employ long-range precision weapons, scouting forces are critical—deploying more friendly assets while corrupting the adversary allows friendly forces to temporarily paralyze the enemy long enough to conduct swarming attacks and then disperse for survival.

While superior situational awareness is critical, it is only effective when irrelevant data is filtered out and only information related to decision making is presented. There must be a balance between realtime continuous fire-control quality data that shows everything in the air and on the surface and only seeing high quality data when targets of interest have been found. This data quality can improve once the decision to engage has been made, which would enable swarming and distributed engagement. It is important to keep this in mind as communications increases one's signature, thus, knowing when to transmit and at what level of quality is important. This is similar to how one would utilize deep reconnaissance or scouting units.

Surface and air surveillance radars and radios on PT boats provided superior situational awareness that facilitated improved elusiveness, standoff, encirclement, and simultaneity—enabling the swarming of forces and fires on adversaries and enhancing the capabilities of larger, more conventional naval military forces. Throughout World War II, PT boats operated in groups of three or more, utilized radars and radios to find the enemy, and employed swarming tactics to attrite adversary forces over time. The lesson for today is that surface and air surveillance radars that can produce fire control quality data when needed can aid in modern swarming attacks of forces and fires. Radars do not necessarily have to be with the forces to conduct attacks, but superior situational awareness does aid swarming forces and fires in effectively engaging the adversary. Sensors and fires can be spread out on the battlefield and do not need to always be co-located with maneuvering swarming forces as long as they are communicating and contributing to situational awareness. Unmanned surface and air surveillance drones can contribute as part of a network to provide superior situational awareness of enemy and friendly forces, allowing for large distributed force and fires to swarm.

Notes

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