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Naval warfare in the littorals has much in common with war conducted on the open ocean. However, there are also some significant differences, due to the extremely complex, dynamic, and challenging physical environment of the former. The peculiarities of the physical environment in the littorals offer many challenges—but also opportunities—in the employment of naval forces and aircraft. Distinctions between characteristics of war on the open ocean and in the littorals must be thoroughly understood; otherwise, commanders and their staffs simply cannot plan or employ their forces properly.

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Perhaps the most important prerequisite of success in littoral warfare is a solid theory developed ahead of time; otherwise it is not possible to organize and train forces properly. Littoral warfare requires the closest cooperation among the services, or "jointness." It also often requires close cooperation with forces of other nations.

The objectives of warfare in the littorals are generally similar or identical to those of war on the open ocean. Yet there are substantial differences in how these objectives are accomplished. In contrast to war on the open ocean, the most prevalent method of employment of combat forces in the littorals is tactical action; opportunities to plan and execute major naval/joint operations are relatively rare. Because of the rapidity and possibly drastic changes in the tactical and operational situations, warfare in the littorals requires a highly decentralized command and control (C2). This means a true application of German-style "mission command"—otherwise, success will be wanting.

IMPORTANCE

The political, military, demographic, and economic importance of the littorals has steadily increased over the past two decades. In 1991, the collapse of the Soviet Union and the Warsaw Pact brought an end to the Cold War. This in turn had a major impact on the international political and security environment. Animosities between various nation-states that had been held in check during the Cold War came into the open. An era of global certainty and predictability was replaced by one marked by uncertainty, turmoil, and chaos.[1] The threat of war between major powers has been reduced, but lesser threats to international order have proliferated, in growing scope, diversity, and frequency.[2] During the past decade Southwest Asia, the Greater Middle East, North Africa, the western Pacific, and most recently Eastern Europe have emerged as the new areas of tensions, conflict, and potentially even major regional wars. It appears that in case of a high-intensity conventional war, combat actions at sea would be predominantly conducted in the littoral waters.

About 80 percent of all countries border the sea, and approximately 95 percent of the world's population lives within six hundred miles of the coast. Some 60 percent of the world's politically significant urban areas are located within sixty miles of the coast, and 70 percent within three hundred miles.[3] About 80 percent of the world's capitals are in the littorals.[4] The littorals account for about 16 percent of the world's oceanic expanse.[5] Yet they are critically important because all seaborne trade originates and ends there. The sea remains the primary, and by far the most cost-effective, means for the movement of international trade. In 2013, about 80 percent of the global trade by volume was carried by ships.[6] The importance of the world's oceans and seas to the economic well-being and security of nations and to the projection of power has perhaps never been greater than it is today.

A blue-water navy now faces much greater and more-diverse threats in the littorals than in the past. This is especially the case in enclosed and semienclosed seas, such as the Persian (Arabian) Gulf. The threat is especially acute within and near the world's international straits, such as Hormuz and Malacca. The threat to one's forces steadily increases as one approaches an enemy coast. The weaker, defending side can have integrated a widely distributed reconnaissance/surveillance system with seagoing platforms, land-based aircraft, air and coastal defenses, ground troops, and special operations forces into an effective multilayered defense. The defender can reach out much farther and more strongly than might be expected, catching the attacking force off guard.[7]

The primary antiaccess/area-denial (A2/AD) capabilities in the littorals are land-based aircraft, diesel-electric attack submarines (SSKs) fitted with air-independent propulsion (AIP), multipurpose corvettes, fast attack craft (FACs), coastal missile/gun batteries, unmanned aerial vehicles (UAVs), midget submarines, sophisticated mines, and medium- and short-range ballistic missiles (MRBMs/SRBMs). In addition, stealthy surface craft armed with small-caliber guns, short-range rockets, or even suicide boats can threaten not only one's commercial shipping but in some cases even larger surface combatants. One of the most serious threats to survivability of large surface ships and merchant shipping, however, is posed by long-range antiship cruise missiles (ASCMs). The most advanced ASCMs can be used against either ships or targets on land. They can be fired by submarines, surface ships, aircraft, and concealed coastal missile sites.

For example, the People's Republic of China is currently developing sophisticated A2/AD multilayered defenses extending several hundred miles from the coast. These defenses consist of space-, air-, and ground-based radars, and over-the-horizon radars, bombers, fighter-bombers, and multipurpose attack aircraft carrying air-to-surface missiles (ASMs) and ASCMs.[8] The Chinese navy is also introducing into service large numbers of modern surface combatants armed with ASCMs, as well as AIP SSKs armed with ASCMs, torpedoes, and mines. Approaches to the Chinese coast are defended by numerous coastal missile and gun batteries. The Chinese have very large inventories of highly advanced mines. They also have at their disposal several hundred SRBMs and MRBMs for use against targets on land. They have developed antiship ballistic missiles with ranges of a thousand miles plus, as well as a highly integrated air-defense system (IADS) with sophisticated surface-to-air missiles and fourth- and fifth-generation fighter aircraft. The Chinese A2/AD assets also include highly advanced and hardened C2 networks, antisatellite weapons, and cyberattack capabilities.[9]

Likewise, Iran is also trying to create multilayered defenses within the Strait of Hormuz and its approaches. Currently, the Iranian navy has in its inventory large numbers of ASCM-armed missile craft, several thousands of mines (both old and very advanced), and several quiet SSKs and midget submarines. ASCM batteries are deployed on the coast and islands within the strait. The Iranian A2/AD capabilities also include a number of land-based attack aircraft armed with ASCMs, UAVs, and several hundred SRBMs and MRBMs. They also have an increasingly sophisticated IADS.[10] The Islamic Revolutionary Guard Corps Navy operates a small number of ASM-armed boats, as well as stealthy torpedo boats; hundreds of small speedboats armed with machine guns, multiple rocket launchers, or ASMs;

remotely controlled radar decoy and explosive-filled boats; and a small number of semisubmersible attack craft.[11]

DEFINING THE TERM

The term "littoral" (from the Latin *litus,* "shore") is often used but is not always properly defined or understood. In its simplest definition, "littoral" means a "coastal region" or "refers to a shore."[12] In geographic terms, the term pertains to a coastline zone between extreme high and low tides. The U.S. military defines the littoral as consisting of two segments of the "operational" environment: seaward (the area from the open ocean to the shore that must be controlled to support operations ashore) and landward (the area inland from the shore that can be supported and defended directly from the sea).[13] Yet this usage is on one hand too broad and imprecise, and on the other, it overlooks a fairly wide range of relevant geographical conditions.

Littorals, properly speaking, encompass areas bordering the waters of open peripheral seas, large archipelagoes, and enclosed and semienclosed seas. Littorals bordering open oceans, such as the coasts of North and South America, Africa, and India, extend outward to the farthest extent of the continental shelf. The width of the continental shelf varies from less than a hundred miles off the west coast of North and South America to nearly eight hundred miles from the Arctic coast of North America and Eurasia. The average width of the continental shelf, however, is between two hundred and five hundred miles. The depth of water on the continental shelf averages 250 feet.[14]

"Peripheral" (or marginal) seas are parts of an ocean bordering the continental landmass and partially enclosed by peninsulas, island chains, or archipelagoes, such as the East China Sea and the South China Sea. They lie on downward-sloping portions of the continental shelf and are uniformly deep. Littorals also include large archipelagoes completely or partially surrounded by open ocean, such as the Malay (or Indonesian) and Solomons Archipelagoes.

The most complex physical environments for employment of naval forces are those of "enclosed" and "semienclosed" seas. An enclosed sea, such as the Baltic or the Adriatic, lies wholly within the continental shelf and is surrounded by a landmass except for a strait connecting it to an ocean or another enclosed or semienclosed sea. Because of their restricted communication with the open ocean, enclosed seas have small tidal ranges or are tideless.[15] Enclosed seas are also called "continental seas" if they rest on shallow depressions, as do the Sea of Azov and the Baltic. In contrast, a semienclosed, or partly enclosed, sea is contiguous to a continent and is linked by two or more straits/narrows to the open ocean; an example is the North Sea. Semienclosed seas are characterized by large tidal ranges.[16]

Enclosed and semienclosed seas are popularly called "narrow seas."[17] In the military meaning of the term, a narrow sea is a body of water that can be controlled from either side. Hence, this term can be properly applied to all enclosed and semienclosed seas, as well as to their long and narrow entrances (such as the English Channel, or La Manche), or certain restricted areas within a narrow sea (such as the Sicilian Narrows). It is in a narrow sea that a blue-water navy, like the U.S. Navy, would likely have the most difficulty in projecting its power ashore.

OPERATING AREA

The operating areas in the littorals differ considerably in terms of their sizes, distances, hydrography, oceanography, and the proximity of the landmass to the open ocean. The oceans themselves are characterized by huge size and distances measured in thousands of miles; the Atlantic Ocean covers an area of some 41.0 million square miles and varies in width from 1,770 miles (between Brazil and Liberia) to three thousand miles (between the east coast of the United States and North Africa). They are uniformly deep, except for the waters off the continents. In contrast, a typical narrow sea presents a much smaller area to be controlled or defended. For example, the Baltic Sea covers 163,000 square miles, extends along its north–south axis for about 920 nautical miles (nm), and has an average width a little over 105 nm. The Persian (Arabian) Gulf is about 615 miles long and between forty and 220 miles wide, with an area of about 92,600 square miles.[18] With its 950,000 square miles, the Mediterranean Sea is the largest of all narrow seas. It extends west to east more than 2,400 miles, and its maximum width is about a thousand miles. The Mediterranean encompasses several smaller narrow seas (the Tyrrhenian, Ionian, Adriatic, and Aegean).

In an enclosed or semienclosed sea, the distances separating various points on the opposing shores are fairly short. For example, in the Baltic Sea, the distance between Kiel and Helsinki is about 625 nm; the port of Tallinn (formerly Reval) is only about 220 nm from Stockholm; some 230 nm separate Copenhagen and Rostock. For the North Sea, the British port of Hull is only about 280 nm from the German port of Emden and some 210 nm from Ostend. The German port of Cuxhaven lies about 475 nm from Scapa Flow, in the Orkneys. Such short distances considerably affect the employment of surface ships, submarines, and aircraft: transit times are short, and high sustained speeds are less critical than in transiting oceans. Small areas combined with short distances allow employment of not only large but also small surface ships and submarines. Units can be deployed and redeployed at short notice and within hours. Submarines, by conducting attacks in various parts of a narrow sea, can create an impression that a larger number of them are present than is the case.[19]

The short distances in a typical narrow sea also allow the use of all types of fixed-wing aircraft and helicopters. Short flying times allow more sorties and longer time over target areas. Aircraft can be quickly deployed and redeployed between various points. The probability of achieving surprise is also greatly enhanced, especially if aircraft approach targets at low altitudes or over land. In addition, a damaged aircraft has a much better chance of reaching the safety of its base than if operating over the open ocean. Finally, short distances allow the side that is stronger in the air to dominate a theater to a far greater degree than on the open ocean.

Lines of operation and lines of communications in enclosed-sea theaters are fewer in number and much shorter than on the open ocean. If a coast is fronted by islands or an archipelago, these lines are predictable to the enemy because they are few in number. Few, if any, alternatives are available. But in a typical narrow sea, shipping routes assume very different patterns: they run along the coast (i.e., longitudinally), from one shore to the opposite one (laterally), or again longitudinally between sea exit(s) and ports of destination within a given narrow sea. They usually have the largest traffic volume and require, of the three categories of routes, the greatest effort to control fully. Longitudinal sea routes, from one port to another along one's own coastline within the effective range of coastal defenses, are generally easier to protect. Where coastal waters are deep, as off Norway, longitudinal sea routes can run very close to shore. It is even easier to protect longitudinal sea routes if the coast is fronted by several island rows, as is the case along the Dalmatian coast. However, longitudinal sea routes are long and few in number; hence, they offer many opportunities for the enemy attack. Attackers can choose parts of the route that are exposed or poorly defended, as well as the time. They have much greater diversity of targets, because coastal routes would be used by many types of commercial and military shipping.[20]

Lateral routes are shorter and more numerous than are coastal routes. However, they are also much more vulnerable to an enemy attack because they run across the high seas, where their defense is difficult; they can be secured usually only near the ports of origin and destination. Friendly ships using lateral routes would be unable to maneuver and seek protection closer to their own coast.[21]

Narrow seas are characterized by the presence of large numbers of friendly, enemy, and neutral commercial vessels, warships, and auxiliaries. In peacetime, waters near coasts are typically crowded with fishing, resource-exploitation, and scientific vessels plus numerous recreational craft. For example, some ninety-three thousand ships passed through the Skaw and the Kiel Canal in 2009.[22] In the Mediterranean, some two hundred thousand merchant vessels larger than a hundred tons, or about 30 percent of the world's maritime shipping, transit every year. Most of that traffic is bound for areas outside the Mediterranean.[23]

The straits connecting narrow seas to the open ocean or other narrow seas are also called "choke points."[24] Density of shipping at the approaches to and within the international straits is higher than on the open ocean. There are several thousand straits in the world, but only between 95 and 121 have international importance.[25] International straits are both the hubs and the most vulnerable segments of sea communications. Several of these—including, notably, those of Hormuz, Malacca, and Singapore—are considered global choke points of world trade, with extremely large economic, political, and military importance. For example, in 2011 seventeen million barrels per day (bb/d), about 35 percent of all crude-oil traffic worldwide, passed through the Strait of Hormuz.[26] In 2011, about 15.2 million bb/d of crude oil passed through the Strait of Malacca.[27] Some sixty thousand ships pass through it each year.[28] If that strait were closed for any reason, almost half of the world's merchant shipping would have to use alternative choke points—specifically, the Lombok Strait (between Bali and Lombok) and the Sunda Strait (between Java and Sumatra).[29] About 3.4 million bb/d of oil was transported through the eighteen-mile-wide Bab el Mandeb in 2011.[30] In 2010, some 2.9 million bb/d passed through the Turkish Straits, seventeen miles long and only half a mile wide; each year some fifty thousand ships, including five thousand tankers, transit this navigationally very difficult waterway.[31]

Straits/narrows are the keys to controlling naval and commercial shipping movements from and to enclosed- or semienclosed-sea theaters. A belligerent that controls both sides of a strait can employ naval forces and establish coastal defenses to prevent an attacker from entering a given enclosed-sea theater. The location, length, width, and depth of a choke point largely determine its economic and military importance. A strait that, like the Strait of Hormuz or the Danish straits, is the only access to an enclosed sea has particular significance.

The length of important straits varies greatly, from the thousand-mile-long Mozambique Channel to the only three-mile-long Strait of Tiran (the entry to the Gulf of Aqaba). The Persian Gulf is linked to the Arabian Sea by the Strait of Hormuz, 120 miles long and twenty-four to sixty miles wide.[32] The 550-mile-long strait of Malacca connects the Indian Ocean and the South China Sea.

Some international straits are very narrow, which greatly affects a ship's speed and maneuverability. For example, the Strait of Malacca is only about 1.5 nm wide at its narrowest point, as is the Phillip Channel in the Singapore Strait. Shallow depth adds to the navigational hazards of some straits; for example, the Strait of Malacca is only seventy to 120 feet deep, while the Bosporus and Dardanelles are 110 and 160 feet deep, respectively.[33] Some straits, however, are very deep, like Gibraltar (1,100 feet) and Lombok (one thousand feet). Navigation through some important straits is made difficult by strong currents. For example, the current in the Shimonoseki Strait (between Honshu and Kyushu) runs at up to eight knots.

The San Bernardino Strait (between Bicol Island, Luzon, and Samar) has tidal currents of four to eight knots.

The configuration and physical features of the coast affect in important ways the length and directional orientation of bases of operations, the organization of surveillance, and coastal defense. The employment of naval forces and aircraft in a narrow sea is greatly affected by length of the coastline, the number and size of natural harbors, the terrain, the presence of offshore islands, the abundance or scarcity of natural resources, and inland communications. When a coast is backed by high mountain ridges and washed by deep water, as is Norway's coast, naval and commercial vessels can sail close to shore, where detection by shipborne radar is more difficult. On elevated or mountainous coasts, communications are often scarce or entirely lacking. If a mountain chain runs close and parallel to the coast, the roads and railroads usually run in the same direction. A steep, rocky, and highly indented coast, or one with fjords separated by rocky headlands and numerous rivers, makes longitudinal communications difficult, while rocky beaches make it difficult to carry out conventional, large-scale amphibious landings.

Generally, a low-lying coast is favorable for the development of the road/railroad network, which can in turn greatly reduce the need for coastal shipping. Conversely, a coast with poor land communications means greater reliance on coastal shipping to transport military and commercial cargo. Land traffic in the littorals can easily be interrupted for long periods, especially if the principal roads or railways run close and parallel to a coast backed by steep, high mountains.

A flat coast with few or no offshore islands is generally favorable to landings by sizable forces. It also facilitates the movement of forces into the interior. Generally, coral reefs and very shallow water extending far from shore favor defense against conventional amphibious assaults. Swamps and marshes in the coastal area can considerably impede or canalize vehicular traffic, especially heavy armor and mechanized forces.

A highly indented coast backed by high ground allows the construction of underground shelters for submarines and small surface combatants. Shelters, usually built of concrete and fitted with heavy steel doors, provide protection against air attack, even with nuclear weapons. They also can offer a range of repair facilities and crew accommodation for several weeks. For example, Sweden has built along its coast what is probably the world's most extensive and sophisticated underground facility at Muskö, near Stockholm. Until much of it was closed in 2004, when the Swedish navy decided to use only its two major naval bases, at Karlskrona and Berga, Muskö had three docks and was able to handle fast attack craft, submarines, and destroyers. China is reportedly building a secret underground naval base at Sanya, on the southern tip of Hainan. There massive sixty-foot-high tunnel entrances are being built into hillsides. The base would reportedly accommodate up to twenty nuclear-powered submarines.[34]

Offshore islands are potentially a great obstacle to any attacker. At the same time, however, they require larger forces for defense. For example, Finland's coast is fronted by some 790 islands larger than 0.4 square miles, plus some 178,500 islets; along Sweden's coast are about 98,370 islands/islets. The Stockholm Archipelago alone consists of about thirty thousand islands/islets. Sweden's coastline, including islands, stretches for some 37,755 miles. Large archipelagoes, as in the Aegean, include many uninhabited islands, which greatly complicate the problem of defense. In contrast, a long coast without offshore islands, such as the Iranian coast in the Persian (Arabian) Gulf, is highly vulnerable to attack from the sea.

Narrow passages between islands can be blocked by mines and coastal missile or gun batteries. Numerous islands canalize the movements of the enemy forces. Several island chains running parallel with the mainland coast extend the defensive depth of the coastal area. A multitude of offshore islands offers the possibility of dispersing bases and thereby making them less vulnerable; small surface combatants can change bases or anchorages in hours. Protected bays or channels offer refuges for ships, and islands conceal the movements of surface ships and troop transports.[35]

If islands extend transversely from the coast, as off Dalmatia's coast, the channels separating them are usually wide and deep, allowing quick, concealed, and relatively easy deployment and redeployment of naval forces. An archipelago, such as the Aegean (1,415 islands) or the Malay (twenty-five thousand, between the Indian and the Pacific Oceans), allows great flexibility in the selection of lines of operation and easy and secure "castling" (leapfrogging) of naval forces. It also provides excellent opportunities for mines in the defense of naval bases, commercial ports, and sea traffic. In general, the more numerous the islands, the more difficult the detection of small surface combatants.

Most narrow seas are characterized by shallow water (less than two hundred fathoms deep). For example, about 60 percent of the Baltic Sea is less than 150 feet deep. The depth of water in the Gulf of Finland varies from 110 to just over three hundred feet. The average depth of the Adriatic Sea is about 650 feet.[36] In the Persian (Arabian) Gulf, the mean depth is about eighty feet, and the water is rarely deeper than three hundred feet; the deepest water is found off the Iranian coast, while depths off Saudi Arabia's coast average 110 feet. Maximum depth in the Yellow Sea is 460 feet, and the mean depth is only 150 feet.[37]

Shallow water restricts, and can even preclude, the employment of major surface combatants. The speed of large surface ships must be considerably reduced when transiting very shallow waters (ten-to-forty-foot depths). In confined waters, such as channels, a ship's speed can be reduced up to 60 percent. The effects of water depth are rather significant for surface ships at speeds higher than twenty-five knots. For example, at thirty knots in eighty-foot depths, wave resistance is almost three times greater than in 115-foot water and five times more than in deep water (more than 1,200 feet).[38] A surface ship proceeding at five, ten, fifteen, or twenty knots requires minimum depths of thirteen, fifty-six, 125, and 220 feet, respectively.[39]

Safe operations by a submarine require certain clearances above the mast and under the keel. Normally, a nuclear-powered attack submarine (SSN) should have a minimum of fifty feet of water under its keel; an SSK needs from thirty-five to forty feet. This figure does not include the much greater depth required for a submarine to maneuver in evading attack. Depending on the water transparency, a submarine may need to operate several dozen feet farther down to prevent detection from the air. At periscope a submarine's keel depth is from fifty to sixty-five feet, depending on sea state and periscope/mast extension. For example, the periscope depth for the German Type 212A is about forty feet. Reportedly, the periscope depth for an American SSN is less than a hundred feet (from the keel).

The character of the seabed can either facilitate submarine operations or make them very difficult. In general, a smooth seafloor allows submarines to lie on the bottom during a pursuit. The presence of shipwrecks can provide a hiding place. An SSK can use bathymetry, bottom composition, topography, and nearby wrecks to hide from pursuers.[40] It would be difficult to detect if it settled on the seabed in less than a hundred feet of water, switched off its engines, and shut all seawater inlets. A bottom-lying SSK looks to sensors like a sunken ship; only a human operator can tell the difference. An SSN, however, cannot sit on the sea bottom, for fear of clogging vital inlets to condensers.[41]

Shallow water considerably complicates the use of less advanced torpedoes by surface combatants and submarines. For example, most advanced lightweight torpedoes, such as the U.S. Mark 46 Mod5A (SW), specially designed for use in shallow water, require a minimum depth of about 148 feet when fired by a surface ship. In contrast, advanced heavyweight torpedoes, such as the U.S. Mark 48 Mod 6 AT, require much greater minimum depth for launching because of their initial negative buoyancy. Yet some heavyweight torpedoes—for example, the German WASS Black Shark—can be reportedly fired even from a bottom-sitting boat.[42]

Shallow water facilitates the use of all types of mines. For example, bottom mines for use against enemy submarines can be laid to a depth of about 660 feet, yet their effectiveness diminishes significantly below 230 feet. Rocket-propelled rising mines can be used down to 650 feet. Antisubmarine rising mines fitted with rocket-propelled torpedoes may be laid in water depths exceeding 3,300 feet. Modern moored mines could be laid at depths from fifteen feet to, depending on their size, five thousand feet or even more. Pressure influence mines cannot be laid at depths greater than a hundred to 165 feet; otherwise they would be ineffective against enemy surface ships.[43]

In general, electronic sensors when used close to a coast are prone to degradation due to a variety of climatic, electromagnetic (EM), and atmospheric anomalies, the presence of a large landmass, human-made clutter, and the proximity of multiple EM sources.[44] The performance of radar, electronic support measures (ESM), and communications systems varies with temperature, pressure, humidity, cloud formation, and storm activity. Another problem is presence of a large number of cellular telephone networks and such commercial land-based emitters as television, commercial aircraft, and ships. This, in turn, creates substantial difficulties in using ESM sensors to sort out and identify emitters or signals of interest.

The combined effect in the littorals of a considerable difference between the temperature of the air and that of the sea and the proximity of landmass often causes nonstandard propagation of EM waves. "Subrefraction" occurs when air temperature decreases or humidity increases rapidly with height, causing EM waves to bend upward or away from the earth's surface. "Super-refraction" takes place when the relative humidity of the air steadily decreases with altitude instead of remaining constant or when the air temperature decreases at a rate less than standard. EM waves can then bend down much more sharply, striking the sea surface, reflecting upward again, curving back down to the sea surface, and so on continuously. Both of these phenomena significantly affect the range of radar and radio communications, and electro-optical (EO) sensors. Subrefraction causes shorter ranges for radars operating within such a layer; super-refraction would extend the range of radars, but targets would appear closer and at higher altitudes than actual.[45] Subrefractive EO propagation causes reduced detection ranges against low-elevation air threats, while super-refractive propagation can present the threat against a background of strong solar glint or infrared clutter.[46]

The extreme case of super-refraction, known as "ducting," or trapping, occurs in conditions of temperature inversion—that is, when a warmer layer of air lies above a cooler layer and EM waves are trapped near the surface. If a trapping layer exists, a duct may form, and it may extend above the trapping layer.[47] Under some conditions ducts significantly extend the propagation of EM waves, but they can also create blind zones where radar cannot detect targets. For example, radar might detect an aircraft flying at five thousand feet at ninety nautical miles but not one at six thousand feet at the same range.[48]

Large land/sea temperature differences often occur in the littorals. This phenomenon is caused by heating over land surfaces during the day while the temperature over water remains fairly constant, generating diurnal lateral movements of air—sea breezes during the day and land breezes at night.[49] Near-shore breezes can cause surface ducts and thereby degrade radar performance.

The performance of the shipboard radars against low-flying aerial targets close to the coast is also adversely affected by land clutter.[50] Doppler radars are able to detect larger targets in the presence of land clutter. In contrast, pulsed radars (which lack perfect waveform stability because the clutter signal is often much stronger than the target signal) have great difficulty in detecting small targets even after the effect of clutter is greatly minimized.[51] Very often false targets are created and actual targets masked. The Falklands/Malvinas War of 1982 illustrates the great problems of using shipborne radars for detection and identification of low-flying targets in the presence of land clutter.[52]

The irregular distribution of shapes and sizes of waves, wind speed and direction, swell height and direction, and biologics can greatly affect radar returns from the sea surface, causing sea clutter. Radar return from the sea surface depends on operating frequency, polarization, and grazing angle. Sea clutter causes difficulties in discriminating small targets, such as submarine periscopes, from background noise. Also, multiple false targets would make detection of targets with low radar cross section (RCS) extremely difficult.[53]

CHARACTERISTICS

Warfare in the littorals has certain characteristics not found on the open ocean. These distinctions are especially pronounced in narrow seas, owing to their small size, short distances, the presence (often) of many offshore islands, and shallowness of water. The operating areas of both enemy and friendly forces encompass not only littoral waters but also coasts, offshore islands, and parts in the interior within the range of shipborne weapons.

Littorals are not isolated theaters of war; they lie on the flanks of troops operating along the coast. In the Italian campaign in 1943–45, for example, the flanks of the Allied armies were on Italy's western and eastern coasts. In the German-Soviet war, the strategic flanks of both sides were the Baltic and Black Seas.[54] Likewise, during the Korean War, 1950–53, the coasts of the Korean Peninsula bordering the Sea of Japan (East Sea, for the Koreans) and the Yellow Sea (Western Sea) represented the flanks of both the United Nations and the North Korean / Chinese ground forces.

In contrast to war on the open ocean, combat action in the littorals can encompass a major part, or even the whole of, a theater, as the North Sea in 1914–18 and the Solomons campaign of 1942–44 illustrate. Numerous actions between small surface combatants took place in the English Channel in 1940–44, the Sicilian Narrows in 1940–43, the Black Sea in 1941–44, and the Adriatic in 1943–45. As noted above, lines of operation in a typical narrow sea and, hence, deployment and redeployment times are rather short. In the struggle for control of the English Channel in 1940–44, lines of operation for the German forces varied from about eighty-four nautical miles at the latitude of Brest to only eighteen at the narrowest part of the Channel.[55]

The restricted maneuvering space in a typical narrow sea, especially with shoals and reefs, is even more confined if one or both opponents lay mines. For example, in the English Channel the operational areas for both the Germans and Allied forces were much reduced by, aside from the many navigational hazards, extensive mined areas. Most of the mine barriers laid by both sides were in the middle of the English Channel.[56] The opposing naval forces were forced to concentrate rather than disperse, facilitating mutual support but making them more vulnerable to attack.

The small size of the typical narrow sea allows both the attacker and the defender to keep a large part of the theater under constant observation. Even the weaker side can conduct continuous reconnaissance throughout the theater. Hence, large surface ships would have difficulty remaining undetected.[57] Smaller hostile ships, however, can take advantage of the high density of shipping traffic combined with the presence of offshore islands and islets to conceal their presence.[58] The presence of noncombatants also makes identification of targets much more complicated than on the open ocean. Shipborne radars would detect low-flying aircraft or ASCMs at much shorter distances than their nominal maximum effective ranges because of the presence of land clutter. Likewise, airborne radars have problems detecting aerial targets flying either very low or over terrain with highly reflective properties.

Detection of the enemy submarines and mines in the littorals is also much more complex and uncertain than on the open ocean. This is largely the result of the prevalent shallowness of water, peculiarities of hydrographic and oceanographic conditions, and high ambient noise. In shallow water, sound propagation is generally difficult to predict, because of great seasonal and daily variations of sea temperature, salinity, waves, tides and currents, any influx of freshwater, and the reflection and absorption due to variations of the seabed. In addition, natural and man-made ambient noise compounds the problem of hunting for submarines in shallow waters.

One of the major problems in using acoustic sensors in shallow water for classification of contacts is a high false-alarm rate. An indented coast fronted by numerous islands and islets makes classifying sonar contacts extremely difficult. In general, the longer a sonar's detection range, notably for passive sonar, the greater the problem; the number of contacts increases approximately as the square of detection range.[59] Many false sonar contacts result from the high irregularity of the sea bottom; underwater cliffs and slopes may resemble submarines lying close to or on the bottom.[60] False contacts result in not only wasted time but unnecessary expenditure of fuel, sonobuoys, and weapons.[61] If the sea bottom is composed of metalliferous rock, magnetic anomaly detectors often produce false alarms.[62] As a result of all the above, detection range of submarines by surface ships is much shorter in shallow water than on the open ocean, especially against quiet SSKs. An SSK that is motionless or moving at less than five knots and is positioned near wrecks or rocky pinnacles is almost impossible to detect with acoustic sensors.[63] Also, submarine-versus-submarine detection ranges are very short because of their improved stealth features, meaning, again, much shorter reaction times.[64]

In comparison to war on the open ocean, warning and reaction time in the littorals is much reduced by short distances and the high speed of modern platforms and weapons. This is especially the case in narrow seas with islands where small surface combatants can hide and attack suddenly at short range. ASCMs can be launched from concealed positions behind islands, the terrain being used to mask their trajectories, leaving very little time for targets to react. The problem of early detection is compounded by land clutter, plus, in some cases, heavy seas.

In the littorals, surface ships are especially vulnerable to the attacks by ASCMs and torpedoes. Supersonic ASCMs fly at very low altitude and can conduct complicated evasive maneuvers in the terminal phase of their flight. For example, an ASCM flying at Mach 2.5 and at low altitude would be detected at a range of fifteen miles; it would take only thirty-three seconds to reach its intended target. Advanced ASCMs can be programmed to escape detection by abruptly changing direction and attacking a different target in the same general area. A target would have great difficulty countering ASCMs fired simultaneously or in a short interval by a combination of aircraft, surface ships, submarines, and coastal sites.

The same challenge of short reaction time applies to heavyweight torpedoes. A typical distance for launching a heavyweight torpedo from a submarine is between 5.0 and 8.0 nm. However, this distance is considerably shorter when torpedoes are launched by a small surface combatant or a submarine in an ambush position.

Missions of small surface combatants in littorals are typically short, because of their short range and low endurance. For example, a combat mission for a missile craft could vary from several to about a dozen hours. The duration of a mission by a small surface combatant would depend not only on its endurance but also on the length of the period of darkness. The latter depends on the time of year and geographic latitude of the operating area. For example, because of Allied air superiority after the summer of 1942, German S-boats (*Schnellbooten,* torpedo boats) based on the occupied coasts of France, Belgium, and the Netherlands were able to operate only at night. During short summer nights the S-boats concentrated their attacks against convoys in the Strait of Dover and the approaches to Plymouth, while in the long winter nights, S-boats based in the Netherlands extended their missions up to the estuary of the River Humber, in England.[65]

The situation on the surface greatly depends on those in the air and on land. Control of a given part of the theater will be directly related to the size of forces present, and the duration of their stay.[66] The high speeds of modern surface combatants and their ability to combine maneuver and "fires," together with the features of the physical environment, potentially allow one side to achieve surprise. The weaker side may not operate in the way one thinks it would, using asymmetric responses to neutralize or even nullify the advantages normally enjoyed by a blue-water navy. The weaker side would try to inflict large losses on the stronger. Its FACs and SSKs can attack from an ambushing position close to the coast or within a group of islands.

One of the main features of naval combat in the littorals generally is frequent and radical change in the tactical and operational situations. In general in the littorals, frequency of contact between opposing forces would be much higher than on the open ocean.[67] Combat there—thanks to long-range, highly precise, and ever more lethal weapons, such as ASCMs, land-attack cruise missiles, advanced torpedoes, and other smart weapons—would be most likely decisive. Most surface combat would be fought at close range; encounters would be sudden, short, and violent. In a war between two strong opponents, the intensity of surface and air combat, and with it consumption of fuel and ammunition, would be very high. As a result, logistical sustainment would be critically important to success.

Because of the ever-present and serious threat from the air, most surface actions in the littorals would take place at night or in bad weather. For example, prior to 1942 British coastal forces operating in the English Channel and the North Sea were highly vulnerable to attack by the Luftwaffe aircraft during the day unless provided effective fighter cover.[68] Hence, most of their missions were conducted during the night. By the summer of 1942, the Luftwaffe's superiority over the Channel had ended. From August 1942 to July 1943, when the majority of German shipping moved along the coast from the Scheldt River estuary southward through the Channel toward southern France, all actions by German surface forces were conducted during the night. This required a high degree of navigational skill because most navigational lights had been shut down. Yet despite all defensive measures, there were frequent attacks by the British coastal forces, mostly motor gunboats and motor launches. The British had a fairly good knowledge of the German routes and used radar to select ambush positions.[69] The British coastal forces too had to operate mostly at night, because a great threat from Luftwaffe aircraft remained.[70]

During the struggle for Crete in May 1941, Admiral Andrew Cunningham, Commander-in-Chief (CINC) of the Mediterranean Fleet, informed the Admiralty in London that the scale of enemy air attacks prevented his ships from operating during daylight hours in the Aegean or off the coasts of Crete. Hence, he warned, the British navy could no longer guarantee that it could prevent seaborne landings without incurring losses that might lead to sacrificing command of the eastern Mediterranean.[71] During the Yom Kippur / Ramadan War of October 1973 the threat from the air forced the Israeli navy to carry out most of its missions during the night hours, as naval battles off Latakia on 7/8 October and Damietta–Baltim on 8/9 October (discussed below) illustrate.

PREREQUISITES

The main prerequisites for success in littoral warfare are suitable and diverse platforms, weapons, and sensors; robust command organization; close cooperation among friendly forces; air superiority; well developed theory; and sound doctrine.

The physical environment in the littorals, in typical narrow seas particularly, requires a naval force differently composed from that employed on the open ocean. Obviously, large surface combatants, such as aircraft carriers, cruisers, and SSNs, could if necessary operate in a typical narrow sea in a time of high-intensity conventional war. However, as noted, their speed and maneuverability would be drastically reduced. They would be also very vulnerable to ASCMs launched by aircraft, small surface combatants, SSKs, and coastal batteries, as well as to small-boat swarms and advanced mines. The risks of operating highly capable but also very expensive platforms outweigh potential benefits. A surface combatant operating in narrow seas should perhaps not exceed 1,200 to 1,500 tons. Common to all ships optimally designed for operations in the littorals are small size, moderately high speed, shallow draft, high maneuverability, moderate range and endurance, and low signatures (radar, infrared, acoustic, and magnetic). Advanced SSKs, light frigates (FFLs), multipurpose corvettes, and FACs are much better suited for combat in littoral waters. Small surface combatants can be employed effectively in shallow waters where large surface ships cannot operate or where risks for them are too high. They are generally more suitable for conducting ASW, defense and protection of friendly shipping, and anti-combat-craft defense. They are also much less expensive and can be built or acquired in larger numbers. Yet for all their advantages, small surface combatants also have a number of deficiencies. They have little space, small buoyancy reserve, and inadequate structural integrity. They are extremely vulnerable to the attacks from the air and by larger counterparts. In case of a hit by a missile or bomb, a small surface combatant has little chance to survive. Because of their small size, enclosed-sea theaters are almost ideal for the employment of land-based attack aircraft, fighters, patrol aircraft, helicopters, and UAVs. Plainly, strategic mobility plays no role for a small coastal navy in the littorals. Because of the shorter distances involved, tactical mobility is almost entirely dependent on the capability to move at maximum speed. In general, high speed for a surface combatant incurs much higher construction costs, greater power requirements, exorbitant fuel consumption, reduced range and payload, increased maintenance, and lower stealth. But for small surface combatants, such as multipurpose corvettes and FACs, high speed is critical not only for mobility but for survivability; they lack staying power and have to avoid pursuit after launching their missiles or torpedoes. Major surface combatants, in contrast, would rarely use speeds higher than, say, thirty knots in a typical narrow sea, because of the shallowness of the water. For them, sustained transit speed, range, and endurance are far more important, because they often have to transit long distances before reaching their operating areas.

Hence, the U.S. Navy did not make a good decision in specifying a speed of more than forty-five knots for its new Littoral Combat Ship (LCS); the result is a platform optimized neither as a small nor as a large combatant. Reportedly the LCS can sail about 1,250 nm at its sprint speed.[72] However, its range at maximum speed is likely to be much shorter. At its sustained speed of eighteen knots, the three-thousand-ton LCS 1 (first of the USS *Freedom* class) can sail 3,500 nm, while the 3,100-ton LCS 2 (the *Independence* class) has a range of about 4,500 nm. In the operating area, according to some reports, the LCS has to be refueled every three days.[73] Further, it cannot operate at its maximum speed in water less than twenty feet deep or in traffic or bad weather (sea state 4 and higher).

As on the open ocean, success in littoral warfare requires employment of diverse combat arms, the deficiencies of each compensated by the strengths of others. This means that not only the weaker but the stronger side as well should possess small surface combatants, advanced SSKs, land-based attack aircraft and helicopters, and UAVs. Yet no single type of surface combatant, however advanced, is a panacea, nor can it offset the absence of forces optimally suited for operations in the littorals. In fact, combat elements of other services and branches —air, army, marines, and special operations forces—should be employed in the littorals as well.

For successful combat in the littorals, a simple and streamlined littoral command structure, with the fewest possible intermediate levels, should be established. For a blue-water navy, like the U.S. Navy, such a command should be composed of multiservice forces under a joint force commander (JFC) and directly subordinate to the theater commander. At the tactical level, the optimal solution is to subordinate directly several joint or combined task forces to the littoral command. Each of these should be composed of two types of elements, arbitrarily called a distant cover and support forces and the littoral combat groups (LCGs). The distant cover and support forces would consist, depending on the mission and the situation, of carrier strike groups, expeditionary strike groups, surface action groups, SSNs, and marine expeditionary units, plus air force attack aircraft and heavy bombers. In some cases, army combat teams can be part of an LCG as well. An LCG would include surface, subsurface, and airborne platforms optimally suited for operations in littoral waters, ideally (though the U.S. Navy currently lacks several of these) FFLs, multipurpose corvettes, FACs, SSKs fitted with AIP, shipborne/land-based multipurpose helicopters, surface mine-countermeasures ships, unmanned vehicles (UAVs / unmanned surface vehicles [USVs] / unmanned underwater vehicles [UUVs]), and special operations force (SOF) teams. Each LCG should be tailored for a particular mission, such as for obtaining/maintaining sea control, denying sea control, or attacking the enemy's or defending friendly shipping. This means that the composition of LCGs should be tailored depending on the mission and the situation.

For a small or medium country, all services of the armed forces deployed in the littorals should be subordinate to a single command commander. Directly subordinate to such a commander should be several maritime or naval district commands, each of them consisting of several maritime or naval combat sectors (zones). At the tactical level, forces for littoral combat might consist of a number of AIP SSKs, multipurpose corvettes, diverse FACs, small amphibious ships and craft, mine-countermeasures ships and craft, land-based helicopters, UAVs/UUVs/USVs, coastal missile/gun batteries, special forces teams, and remotely controlled minefields. These forces should be organized in combat groups depending on a particular mission. They should be supported by land-based fighter, attack, and reconnaissance aircraft and larger army units. The emphasis of smaller and medium navies would be primarily on sea denial.

In World War II, the British and the Germans established command organizations for their respective coastal forces struggling for control of the North Sea and the English Channel. The Royal Navy established main bases for its coastal forces in East Anglia, at Great Yarmouth, Lowestoft, and Felixstowe. They were responsible for administration and maintenance of light forces operating from them. However, operationally these forces were controlled by CINC, the Nore, at Chatham. In February 1943, an intermediate level of command was created with the establishment of Coastal Forces (Nore), under a navy captain. The main responsibility of this new command was to unify training of all coastal forces according to a common doctrine.[74]

The German organization was in some ways similar to the one established by the British. After reorganization in February 1941, Commander of Security, West (Befehlshaber der Sicherung West), with headquarters in Paris, was responsible for defense of the French Channel and Atlantic coasts. He was directly subordinate to Naval Group Command West (Marinegruppenkommando West) (after September 1942 also Commanding Admiral, France), in Paris. Commander, Naval Group Command West was subordinate not to the CINC of the western theater but directly to the High Command of the Navy in Berlin. He had under him three security divisions: the 2nd (responsible for the zone from the Scheldt estuary to Cherbourg), the 3rd (Cherbourg to Saint-Nazaire), and the 4th (Saint-Nazaire to the Spanish border). In November 1942, the 6th Security Division was established and was responsible for defense of southern France's coast. Each security division consisted of flotillas of picketboats, submarine chasers, minelayers, and minesweepers. The principal mission of Commander of Security, West was defense and protection of cargo vessels carrying important raw materials (e.g., iron ore from Spain).[75]

The S-boats, which played a principal role, were subordinate to Naval Group Command West, but via Commander of Scouting Forces (Befehlshaber der Aufklaerungsstreitkraefte) and the Leader, Torpedo Boats (Fuehrer der Torpedoboote). This rather rigid command structure soon proved inadequate; in the spring of 1942, Leader of Torpedo Boats was renamed Leader, S-Boats (Fuehrer der Schnellboote). This new organization provided more flexibility in command and control of the S-boats. The Germans established their S-boat bases in Rotterdam, Ostend, Boulogne, and Cherbourg. In addition, the bunkers at Le Havre for R-boats (*Raümboote,* minesweepers), were used by S-boats, as were the smaller ports of Vlissingen (the Netherlands), Saint-Malo (Brittany), and Saint Peter Port (Guernsey).[76]

Today, smaller navies operating in the littorals are organized in either naval districts or naval flotillas. For example, the Iranian naval forces in the Persian Gulf are subordinate to three naval districts: the 1st Naval District, at Bandar Abbas, for the Strait of Hormuz; the 2nd Naval District, at Bushehr, for the central Persian Gulf; and the 3rd Naval District, at Mahshahr, for the northern Persian Gulf. Each naval district includes several naval bases; the independent naval base at Chabahar is responsible for operations in the Gulf of Oman.[77] In contrast, the Royal Swedish Navy's seagoing forces are organized into three flotillas: the 1st Submarine Flotilla, at Karlskrona (submarines, a submarine rescue unit, a marine transport unit); the 3rd Naval Flotilla, at Karlskrona (33 Mine Clearance Division, 34 Maintenance Division); and the 4th Naval Flotilla, at Berga (41 Corvette Division, 42 Mine Clearance Division, 43 Maintenance Division, 44 Navy Diver Division). In addition, there is an amphibious regiment and a naval base, both at Karlskrona.

Littoral warfare is inherently joint (multiservice) and often combined (multinational). In the modern era, no single combat arm or service can reach its full potential unless it is employed in combination with other combat arms, branches, and services. Among other things, shortcomings in the capabilities of one service can be balanced by the complementary capabilities of others. A JFC has more options than a single-service component commander in employing his forces, because sea, land, air, and special-operations elements offer a wider range of possibilities. At the same time, the enemy is put at a great disadvantage against a multidimensional threat for which he might not have an effective counter. Multiservice forces allow a creative operational commander to combine their diverse but complementary capabilities in asymmetrical as well as symmetrical ways and generate greater impact than the sum of the individual parts.[78] For example, missile-armed surface combatants can attack a variety of targets on the enemy coast, while land-based aircraft can strike enemy warships and merchant ships at sea or in their bases and ports. Friendly ground forces can seize enemy naval bases, ports, and airfields and thereby greatly facilitate the task of obtaining sea control.

Joint employment of two or more services also has some disadvantages. One is that command organization / C2 is more complex than in the employment of single-service forces. The different service cultures and doctrines might lead to misunderstanding and make cooperation difficult. Other potential challenges include parochialism of services, personal incompatibility (or even animosity) among high commanders, poor operations security, and insufficient interoperability. Communications arrangements are more cumbersome because of differing systems and procedures used by various services. (This is an especially difficult problem to resolve in employing multinational forces.) Deployment of combat forces and logistical support and sustainment also pose much greater challenges than for single-service forces. Information flow within a multiservice or multinational force is also generally much slower than in a single-service force.

Perhaps the most critical prerequisite for success in littorals is air superiority over the major part of the theater. The struggle for the control of the air in the littorals cannot be separated from that in the airspace over adjacent coastal areas. Because of the short distances, the effectiveness of aircraft against ships and targets on the coast is much higher in a typical narrow sea than on the open ocean. Aircraft represent a constant threat to the survivability of all vessels, but especially to surface ships. The ever-present threat from land-based aircraft can even preclude the employment of large surface combatants in a narrow sea. Their survivability and that of merchant vessels while operating within the effective range of enemy land-based aircraft can be ensured only by reliable and effective air cover. The effectiveness of land-based aircraft against surface ships was demonstrated for the first time in European waters in World War II. The Luftwaffe was instrumental for the successful German invasion of Norway in April–June 1940. The Royal Navy's failure to deny the use of the sea to the Germans in the first days of the campaign was a result of the intensity and effectiveness of the Luftwaffe attacks when protection was not provided by Allied fighters based ashore.[79]

The Luftwaffe's effectiveness in attacking the surface combatants was on full display during the final phase of the struggle for Crete in late May 1941. The Royal Navy was extensively committed to evacuating troops to Alexandria, Egypt. During this effort Allied ships were subjected to massive attacks from the Luftwaffe's VIII Air Corps. One effect of these attacks was to force the Allies to abandon attempts to evacuate troops from Crete's northern coast.[80] Luftwaffe bombers and dive-bombers sank three Allied cruisers, six destroyers, five motor torpedo boats, and several smaller ships.[81] In addition, two battleships, one aircraft carrier, six cruisers, and seven destroyers were damaged. Some thirty-two Allied transports, supply ships, and fleet auxiliaries with about 128,500 tons were sunk or had to be abandoned, and twelve ships with 94,500 tons were lost at sea.[82] Admiral Cunningham pointed out that in three days he had lost two cruisers and four destroyers, as well as a battleship, two more cruisers, and four destroyers severely damaged.[83] The struggle for Crete shows that in the modern era sea control cannot be obtained without the control of the air. The answer to enemy airpower can only be superior airpower.[84]

Success in littoral warfare is hardly possible without sound theory. The theory of littoral warfare should be a separately developed but at the same time an integral part of the theory of naval warfare as a whole. One of the main purposes of naval theory is to provide a broad and deep framework for understanding the entire spectrum of warfare at sea. However, a major problem is the lack of a coherent theory of littoral warfare. Classical naval thinkers—notably Rear Admiral Alfred T. Mahan (1840–1914), Vice Admiral Philip H. Colomb (1831–99), Sir Julian S. Corbett (1854–1922), Vice Admiral Wolfgang Wegener (1875–1956), and Vice Admiral Raoul Castex (1878–1968)—generally drew no distinction between warfare conducted on the open ocean and in the littorals. Yet all of them discussed from a historical perspective many naval encounters that occurred in the littorals. Mahan, in his *Naval Strategy: Compared and Contrasted with the Principles and Practice of Military Operations on Land* (1911), explained in some detail many aspects of what would be considered today operational-level warfare in the littorals. Colomb, in *Naval Warfare: Its Ruling Principles and Practice Historically Treated* (1891), provided numerous historical examples of war in the littorals in his analysis of what he called "the struggle for the command of the sea" and "attacks on the territory from the sea."[85] Corbett, in *Some Principles of Maritime Strategy,* made many references to the role of naval forces during the Anglo-Dutch Wars (1652–54, 1665–67, and 1672–74) in the English Channel and North Sea, the British blockade of the French fleet in Atlantic ports and the Mediterranean during the Napoleonic Wars, the Royal Navy's support of the army of General Arthur Wellesley (later Field Marshal, First Duke of Wellington) (1769–1852) during the Peninsular War (1808–14), and the naval actions in the

Yellow Sea during the Russo-Japanese War (1904–1905). Wegener's main focus, in his *Naval Strategy of the World War* (1929), was on explaining the Imperial German Navy's failure to obtain freedom of action outside the confines of the North Sea; he explained in some detail the strategic situation in the North Sea during World War I.[86] Castex wrote the five-volume *Strategic Theories* (1929–35), where he paid a great deal of attention to historical analysis of warfare in the littorals. Among other things, Castex analyzed the German operations in the North Sea and the influence of geography in naval warfare.[87] Colonel Charles E. Callwell of the British Army, though not widely known, was perhaps one of the first influential proponents of joint warfare in the littorals. In his classic work *Military Operations and Maritime Preponderance* he described and analyzed in great detail naval bases and fortresses and their capture by fleet forces, land operations against enemy fleets and merchant shipping, and the benefits of having "maritime command" against an enemy stronger on land. He also compared maritime and land lines of operations. Callwell explored influence of "maritime command" on military lines of operation in the coastal area. A major part of his work was focused on amphibious landings and siege of "maritime fortresses." He also devoted a long chapter to the influence of inland waters and waterways on military operations.[88]

Optimally, foundations of a theory of littoral warfare should be historical experience and the vision of the future war at sea. The latter is based primarily on the influence of the current and anticipated new technologies on the character of war at sea. Overemphasis on either historical experiences or technology would invariably result in an unsound naval theory. It is an especially grave error to develop naval theory and then doctrine based on exaggerated belief in the value of new technologies. Also, a naval theory should not be developed on the basis of fiscal difficulties of the moment or political ideology. In all these cases, the result will be a naval theory disconnected from the operational realities. Examples of naval theories that made both kinds of errors are the "Young Schools" of France (the *Jeune École*) of the mid-1870s to the early 1900s and of the Soviet Union, in the late 1920s and mid-1930s.

The French Young School was based almost entirely on an exaggerated view of the benefits of the new technologies and on mislearned lessons from the Austro-Italian War of 1866, reinforced by France's dismal economic situation in the aftermath of the war with Prussia in 1870–71.[89] Its leading proponent, Vice Admiral Hyacinthe Laurent Théophile Aube (1826–90), contended that command of the sea, obtained through a naval battle or blockade, had become highly problematic because of the new technological advances. Aube's ideas were widely accepted by young French naval officers, who believed that they had found a new naval warfare concept for attack on and defense of the coast—a network of "sleeping" torpedoes and coastal fortifications, combined with ram ships, floating batteries, and high-speed, seventy-ton, twenty-knot gunboats, and torpedo boats, as well as fifty-ton "defensive" boats supported by armored ships.[90] These views also found a receptive audience in Austria-Hungary, for reasons that were political, military, and fiscal.

The Soviet "Young School," which emerged in the 1920s (in opposition to an "Old School" of Mahanian former tsarist officers), was based on the poor state of the Soviet Union's economy and fleet, its Marxist-Leninist ideology, and principles of partisan (guerrilla) warfare. Its proponents advocated a navy composed of light surface combatants, submarines, mines, and land-based naval aircraft; they also advocated employing submarines jointly with air forces against large surface ships.[91]

Despite the shared name, however, the Soviet Young School's ideas were not identical to those of the French Young School of the 1880s; arguably the Soviet strategy was defensive, not offensive, as the French strategy was.[92] Both, however, produced theories potentially applicable to littoral warfare—but only, as it were, accidentally, on the basis of unrelated and transient national factors, not a true understanding of naval warfare. Neither school produced forces or concepts viable for naval operations in the littorals, though both were preeminent for a number of years in their respective countries (and, for the *Jeune École,* in Austria-Hungary as well). Both were abandoned when national situations changed.[93]

A sound doctrine, regardless of its scale, should revolve around several "operating concepts." An operating concept can be tactical or operational; in a naval context, a "tactical concept" describes in broad terms the employment of single-type platforms or groups. An "operational concept" aims at operational-level objectives through major naval or joint operations. An operational concept specifically for littoral combat should be based on a proper assessment of the operating area and a realistic vision of future warfare in it. It should describe in broad and simple terms how forces should be employed. It should not directly or implicitly refer to a specific operating area or the potential enemy.

An operational concept should be flexible to allow creative ways to employ one's forces in case of sudden changes in the situation. It should ensure speed of action and surprise. It should pose a threat from multiple physical mediums (sea, air, and land) and thereby considerably limit the enemy's options. It should also provide for operational deception and surprise. It should integrate both offensive and defensive information operations (IO) capabilities. Finally, an operational concept should be articulated clearly and succinctly.

In U.S. practice, an operational concept encompasses a number of "functional concepts" to ensure its effective application in combat. The principal types of functional concepts are notional force composition, command organization, command and control, maneuver, fires, sequencing and synchronization of combat forces, logistical support and sustainment, and force protection. Each functional concept in turn comprises a number of "enabling concepts," describing tactics and procedures.[94]

A sound doctrine for littoral warfare should encompass several different operational concepts. For the stronger side the key operational concept should be sea control, while for the weaker side the focus should be sea denial. However, prudence also dictates that a stronger side should develop an operational concept for sea denial as well. Doctrine for littoral warfare at the operational level of war should include operational concepts for amphibious landings, antiamphibious defense, attack on enemy trade, and defense and protection of friendly maritime trade. Littoral warfare doctrine should also include tenets of operational command organization, C2, and leadership; operational decision making and planning; and operational (supporting) functions (intelligence, IO, fires, logistics, and protection). Doctrine for littoral warfare cannot be written as a stand-alone document; it should be developed as an integral part of a navy's doctrine for the operational level of war. Warfare on the open ocean and warfare in littorals are inseparable parts of warfare at sea as a whole.

OBJECTIVES

In general, the principal objectives of naval warfare are sea control, sea denial, choke-point control or denial, basing/deployment-area control (or denial), and destruction or weakening of the enemy's military-economic potential at sea, and preservation of one's own. Although there are many similarities among the main methods used on the open ocean and in the littorals for accomplishing these objectives, there are also considerable differences. Normally, the principal objective of a stronger side at the very beginning of hostilities would be to obtain and then maintain sea control—the ability to use a given part of the sea or ocean and associated airspace for military and nonmilitary purposes and deny the same to the enemy during open hostilities.

Sea control exists in various degrees and states (spatial extents). These variations are the product of a complex interplay among the factors of space, time, and force. Generally, the degree of sea control depends on the size of the ocean/sea area; distances to the operating area from one's basing/deployment area; and relative numerical/qualitative naval strength (plus in some cases nonnaval forces) compared with the enemy forces.

Control of the surface is relatively easier to obtain in a narrow sea with a few or no offshore islands. Narrow seas with large numbers of offshore islands or archipelagoes pose the greater challenges because of the numerous hiding places, especially for small surface combatants. The presence of advanced SSKs and sophisticated mines would make it extremely difficult to obtain the desired degree of control of the subsurface in the littorals. Control of the air is perhaps even more elusive, especially in the littorals, with a multitude of offshore islands or archipelagoes.

The spatial extent of sea control can be general or local or a combination of these two. General control means a loose control, mainly sea surface, of a larger part of a given maritime theater. Local sea control is intended to obtain and maintain a high degree of control in all physical dimensions but in a smaller part of the theater where an operational objective is located. It depends on the general situation in a given maritime theater.[95] Sometimes a stronger side possesses a general control of a maritime theater but local control is in the hands of a weaker opponent. For example, in the aftermath of the landing at Leyte on 20 October 1944, the Allies controlled Leyte Gulf and the approaches to the Philippine Archipelago generally. However, they did not control the western approaches to Leyte Island, especially during the night hours and in bad weather. This situation, in turn, allowed the Japanese to bring in fresh troops and matériel to Leyte from nearby islands in the Visayas and near Mindanao;[96] they used mostly barges but also transports, submarine chasers, and destroyers, until 9 December. The main reason for the Allied failure in the western approaches to Leyte was a lack of ships larger than PT boats but smaller than destroyers and capable of operating in confined waters, and also of sufficient aircraft fitted with radar for operating at night.[97]

Sea control on the open ocean cannot be isolated from control in the littorals. At the same time, the influence of land is far more pronounced in a typical narrow sea than it is on the open ocean. There is no real sea control unless a stronger side controls both the sea and adjacent land area.[98] In a narrow sea, control of the high seas does not necessarily mean control of waters within the groups of islands or archipelagoes. Success in the struggle for sea control requires the closest cooperation among all services.[99]

On the open ocean, sea control is obtained primarily by destroying or at least neutralizing a major part of the enemy's forces at sea or their basing areas. In contrast, in a typical narrow sea, a side weaker at sea but having stronger ground forces and air superiority could obtain sea control largely by capturing the sea's exit(s), the enemy's main naval bases and airfields, and key islands. For example, and despite the inferiority of the Kriegsmarine, the German army, with the support of the Luftwaffe, essentially obtained sea control over the eastern part of the Baltic and the Gulf of Finland in the initial phase of the invasion of the Soviet Union on 22 June 1941. Army Group North advanced quickly along the Baltic coast in the first few weeks and by September 1941 had seized the entire coast (except the eastern part of the Gulf of Finland), including the large Soviet naval bases at Leningrad and Kronshtadt. Hence the Germans and the Finns could operate in the Bay of Kronshtadt to destroy the remainder of the Soviet Baltic Fleet.[100]

In June 1941, the Germans relied on their army's rapid advance along the coast of the Black Sea coast to obtain control of that sea. Army Group South advanced through southern Ukraine to seize the Crimean Peninsula, with its large naval base at Sevastopol, and other, Ukrainian ports. Despite bitter Soviet resistance, by October the Germans occupied most of the Crimea, including the Kerch Peninsula. Yet the Sevastopol fortress did not fall into German hands until early July 1942. The German offensive in southern Russia in that summer led to the capture of almost all the remaining Soviet naval bases and ports in the Black Sea. However, Tuapse, Poti, and other smaller bases along the southern Caucasian coast of the Black Sea were never captured by the Germans; having failed to eliminate the Soviet naval forces completely, the Germans never obtained full control of the Black Sea. Soviet naval forces remained a constant nuisance for German supply traffic on the Black Sea.[101]

For the weaker side in the littorals, the principal objective would be to deny control of the sea to the opponent—that is, frustrate partially or completely the enemy's use of the sea for military and commercial purposes. Alternatively, a state of disputed or contested sea control might exist, in which the opposing sides possess roughly equal strength, there is no significant change in the ratio of forces, and the initiative does not shift to either side.[102] Such a situation is characterized by an almost continuous struggle for control, which when achieved is usually maintained for only a short time and then lost and then obtained again. Disputed sea control is characterized by large losses on both sides.

A stronger side can have a high degree of control on the open ocean but much less closer to the continental landmass. Complete control of a narrow sea cannot be obtained as long as the opponent, however weak, exists and is active. For example, during World War I, the British Grand Fleet never had control of the eastern and southeastern part of the North Sea. Likewise, control of the Adriatic was essentially in the hands of the Austro-Hungarian navy throughout the entire war.[103]

In the past, weaker navies achieved results by attacking enemy coasts or maritime trade while avoiding fleet-on-fleet encounters. For example, in World War I, the German navy harassed the British and conducted minor actions to reduce the British margin of superiority to such an extent that eventually the High Seas Fleet (Hochseeflotte) took the offensive.[104] The Germans also hoped that successful attacks on the Entente's trade routes might force the British to divert some of their naval strength and thereby make the Grand Fleet more vulnerable to ambushes by light surface forces. Containment of the High Seas Fleet required the presence of British ships that otherwise could have been doing something else. Also, decisive actions against U-boats, such as laying an effective mine barrier off the German coast, could not be undertaken during the entire war, because of the presence of the German battle fleet in the area.[105]

The struggle for control of straits/narrows or "choke points" is a unique feature of the control of enclosed or semienclosed seas. To control a narrow sea a blue-water navy must first control the sea's exits. This could be limited to control of the airspace above it, but obviously full control of the exit in all three physical dimensions (surface, subsurface, air) is far preferable. For a blue-water navy, general control of the open ocean is hardly possible without establishing not only general control of waters adjacent to a narrow sea but also control of its exits/entrances. Conversely, for a riparian state it is absolutely critical to have free access to open waters beyond the confines of the narrow sea on which it lies. Choke-point control, then, is an offensive objective for a stronger side, and denying that control—an easier task —is a defensive objective for the weaker. Not only naval forces but other services as well would be employed, either way.

A great advantage for a weaker opponent in such a case is that its forces would operate along multiple and much shorter lines of operation and retreat. The blue-water opponent can use only a single line of operation and a single line of retreat. Another advantage of the weaker force is that sometimes it may be able to seize and maintain sea control of a strait and its approaches with nonnaval forces alone.

Experience shows that control of a sea's only exit is usually insufficient to deny the weaker fleet freedom of action within a given narrow sea; full or partial control of operationally significant positions must be obtained as well. For example, in World War I, the French fleet blockaded the Strait of Otranto early in the war but made only occasional forays farther north into the southern Adriatic. This left the much weaker Austro-Hungarian fleet almost undisputed control of the Adriatic throughout the war. Had the Entente navies made a strong effort to destroy the Austro-Hungarian fleet, they could have prevented the German and Austro-Hungarian U-boats from carrying out their deadly attacks on Entente shipping in the Mediterranean.[106]

In another example, during World War II the Allies had strategic control of the Mediterranean because they controlled the Strait of Gibraltar and the Suez Canal. (Turkey being formally neutral, neither the Allies nor the Axis controlled the Turkish Straits.) Within the Mediterranean, the Allies controlled in 1940–43 only a single operationally significant position, the island of Malta; the Bonifacio Strait, the Strait of Messina, and the Strait of Otranto were in the hands of the Axis, while control of the Sicilian Narrows was disputed.

Choke-point control can also cut off an enemy's links overseas. Conversely, blocking a choke point from within the enclosed sea to prevent any outside force from entering is a form of self-blockade, usable only if no further offensive actions are planned.[107]

Another objective of naval warfare in the littorals is to ensure the security of basing and deployment areas; otherwise it would be difficult, if not impossible, to obtain, maintain, or deny sea control. At the beginning of hostilities the stronger side would try to expand its own basing and deployment areas and prevent the weaker side from doing the same. Basing/deployment-area control is one of the primary responsibilities of the operational commander. It is an integral part of theater-wide or operational protection. Not only naval forces but those of other services would be employed.

Basing/deployment-area control is an operational objective accomplished by a series of tactical actions and protection measures conducted during the entire war at sea. The principal defensive tactical actions include reconnaissance and surveillance; patrolling of the approaches of one's naval bases, ports, and selected parts of the coast; air, antisubmarine, and anti-combat-craft defense; defensive mining and mine countermeasures; and defense against commando raids and combat swimmers. Offensive tactical actions include destruction of enemy surface combatants potentially threatening one's naval bases/ports, attacks on the enemy's naval/air bases and ports and installations/facilities on the coast, and laying of mines in the enemy's coastal waters. Protection of basing and deployment areas is significantly enhanced by a variety of passive and active measures, such as the countering of enemy reconnaissance or surveillance, electronic warfare, and cover and concealment. Additionally, a number of protective measures can improve the survivability of forces, coastal installations, and facilities. Once obtained, basing/deployment control must be maintained, and everything possible done to deny the same to the opponent.

"Trade warfare" or "economic warfare"—attack on the enemy's maritime trade and defense and protection of friendly shipping—is an integral part of a much broader task of weakening or destroying the enemy's military-economic potential and protecting one's own. In the littorals, the priority is shipping at sea / in ports, ports, shipyards and ship-repair facilities, installations critical for supply and sustainment of forces on the land front, the needs of war industry, and the population.[108] This task is much more difficult for a weaker side because of its inability to ensure an adequate degree of sea control. But it can still protect sea routes close to its coast and within island chains, if it establishes multilayered defenses. In general, maritime traffic is much easier to defend if friendly troops control the coastal area, including naval bases, ports, and airfields.

METHODS

The principal methods of combat employment of naval forces generally are tactical actions, major naval operations, and maritime campaigns. Naval warfare in the littorals would be characterized by numerous and diverse tactical actions fought on the surface, beneath the surface, and in the air. Minor tactical objectives would be primarily accomplished by attacks and strikes, while major tactical objectives would normally require naval raids, engagements, or battles. Naval tactical actions are normally an integral part of major naval/joint operations but they could be, as the example of the Solomons campaign of 1942–44 illustrates, also conducted independently. Yet they should be invariably part of a given operational framework—that is, contributing directly or indirectly to the accomplishment of a given operational or strategic objective. For example, between 9 August 1942 and 25 November 1943 fifteen major surface actions were fought in the waters around the islands of Guadalcanal, New Georgia, and Bougainville. All of them were a part of the struggle for sea control in the Solomons Archipelago and its approaches. All but three of these actions were fought at night. The Japanese (who were much better than the Allies in night fighting and the use of gunnery and torpedoes in combination) won or achieved draws in ten of them. No fewer than seven naval battles and engagements were fought for Guadalcanal alone. The Japanese losses (including the fighting off New Guinea and the Bismarck Archipelago) amounted to two battleships, one small aircraft carrier, three heavy and three light cruisers, and thirty-six destroyers. In addition, Japanese naval air strength was so severely depleted that the air wings of fast aircraft carriers could thereafter no longer be properly manned. An even more serious problem for the Japanese was that new construction was unable to make up for the losses. No more battleships or heavy cruisers were built by the Japanese, and only half of the lost destroyers were ever replaced.[109]

During the Yom Kippur / Ramadan War of October 1973 the Israelis fought two naval battles, one each with the Egyptians and the Syrians. In the night of 6/7 October, a force of five Israeli missile boats patrolled off Syria's coast, some two hundred miles from their home base. The Israeli boats identified and then sank with gunfire one Syrian torpedo boat at about 2230. The same force then swept the Syrian coast off the port of Latakia and sank one Syrian minesweeper with gunfire, before detecting three Syrian missile boats and one minesweeper at about 2335. In the subsequent missile exchange, all three Syrian missile boats were sunk within twenty-five minutes.[110] In the night of 8/9 October, six Israeli missile boats approached the Egyptian coast to shell the military installations and coastal defenses in the area of Damietta. Around midnight, four Egyptian missile boats engaged them. Three of the Israeli missile boats launched their missiles, and within forty minutes three Egyptian boats were sunk; the fourth was out of range and escaped to safety.[111]

The principal method of combat employment to accomplish a single operational objective in littorals is a major naval operation—a series of major and minor naval tactical actions fought on the surface, under the surface, and in the air. A major naval operation in the littoral should be planned and conducted by a single commander and in accordance with a common operational idea (scheme). Many major naval operations were conducted during World War II in the littorals. The best-known examples are the battle of Matapan on 27–29 March 1941; escape of the German battle cruisers from Brest through the English Channel, 11–13 February 1942 (Operation CERBERUS); convoys to Malta on 12–15 June 1942 (Operation HARPOON/VIGOROUS) and on 10–15 August 1942 (PEDESTAL); and amphibious landings on Sicily on 10 July 1943 (HUSKY), and at Salerno on 9 September 1943 (AVALANCHE). The most recent example of a major naval/joint operation in the littorals was the British recapture of the Falklands/Malvinas on 2 April–14 June 1982 (Operation CORPORATE).

Because of the overlap of the physical mediums in which services operate, major operations in the littorals conducted predominantly by a single service would be very rare. All major amphibious landing operations are inherently joint/combined (multinational), regardless of the physical environment; also, attacks on major naval bases and ports, support of the coastal flank of friendly troops, and attacks on and defense of maritime trade in narrow seas require the closest cooperation among the services. Naval forces will have the principal roles, nevertheless, in major operations designed to destroy or neutralize enemy fleets at sea or their bases. The weaker side will have few if any opportunities to plan and execute major naval/joint operations to deny sea control, but it would often conduct major operations in antiamphibious defense and the defense of major naval bases and ports. It might also plan major operations in defense of shipping.

Major naval/joint operations should be planned, prepared, and conducted by a naval/maritime component commander. In U.S. terms, joint/combined maritime force component commanders designated at theater-level commands have sufficient forces for obtaining and maintaining sea control in the littorals. That responsibility should not be shared by the air component commander; sea control means control of not only the surface and subsurface but the air as well. Divided command not only would invariably complicate the accomplishment of objectives in major naval/joint operations but also might prove quite detrimental. The planning, preparation, and execution of naval/joint operations in the littorals are highly dependent on uninterrupted, fast, and secure communications to participating forces. Speed of communications is perhaps one of the most critical factors for success in combat in the littorals.

A weaker side at sea can use unconventional and asymmetric tactical methods to inflict losses on its stronger opponent. One relatively new method involves so-called swarming attacks, in which a large number of small, fast boats, hidden in coves on the coast or among islands, would launch massive missile strikes against large surface combatants or commercial vessels. Success would primarily depend on synchronization of the delivery of almost simultaneous attacks by many small boats from different directions, to overwhelm missile defenses. For example, the Iranians reportedly intend to use swarming attacks against the U.S./coalition naval forces operating in the Persian (Arabian) Gulf, and especially when transiting the Strait of Hormuz. Swarming attacks would be conducted at short ranges, perhaps not greater than 6,500 feet.[112] Another swarming tactic that could possibly be effective against large surface combatants would use UAVs, either independently or in combination with massive attacks by small, fast, missile-armed craft. The danger that swarming attacks might pose to major surface combatants, especially in confined waters like the Strait of Hormuz, should not be underestimated by a blue-water navy, including the U.S. Navy.

COMMAND AND CONTROL

C2 of naval forces operating in the littoral waters is generally more challenging than in warfare on the open ocean. Because the small size of the operating area and high intensity of combat would cause sudden and often drastic changes in the situation, the main prerequisites for success would be the largest possible degree of local initiative. This means that true German-style "mission command" should be applied. The commander's intent should afford sufficient freedom of action by subordinates at all levels of command. Unnecessary interference with the responsibilities of subordinate commanders cannot but negatively affect the morale and combat motivation, resulting in passivity and unwillingness to take the initiative. Short warning and reaction times and rapid changes in the situation require full exercise of the initiative at all levels and high tactical skill.[113] However, mission command is not absolute—the higher commander is duty bound to intervene, either reversing decisions or replacing subordinate commanders, when subordinates' actions endanger the success of the mission or jeopardize the missions of neighboring commanders.

Mission command requires highly educated and well trained subordinates; otherwise directive orders must be used. The higher commanders and their subordinates must share in mission accomplishment. This implies complete trust in each other's professional and personal qualities. In littoral warfare, personal relationships between commanders and their subordinates are especially critical, given the small crews involved and immediate personal danger. Hence, great attention must be given to unit cohesion on board individual ships and forces.

Networking of surface ships, aircraft, and submarines is potentially beneficial in the open waters off a continental landmass, such as off the coast of Africa or in the Indian Ocean. Yet the weaker side at sea could obtain even greater benefits by knitting together its seagoing and shore-based forces and thereby obtaining a real- or near-real-time picture of the situation in the initial phases. It can also effectively integrate employment of all naval and other forces in denying access to its littorals.

In a war between two strong opponents, tactical commanders would have much less time than in open waters to estimate situations and make sound decisions. Advanced information technologies allow commanders to share information obtained from the common operational picture (COP) and cooperative engagement capability (CEC). A COP provides to all commanders an integrated, graphical depiction of the battle space based on a single, shareable set of data. It presents the current locations, statuses, and often planned movements of friendly, neutral, and enemy ground, maritime, and air forces. It can also display other information, such as the weather and battle-damage assessments.[114] Depending on the level of command, it is possible to choose what information to display. A potential problem is that commanders looking at the same data might interpret them differently and therefore form different pictures of the situation.[115]

A COP is developed by correlating and fusing data from multiple, dissimilar data sources, such as tactical data links, reconnaissance/surveillance, and sensor networks. Currently, tactical data links provide the bulk of the data that constitute the COP. These data inputs are often huge, originating from overlapping sensor systems and passing through links that are unable to segregate redundant and erroneous data before they are all fused into a COP.[116] To eliminate false and redundant data across subnetworks and prevent them from entering the COP requires extensive cross-checking and filtering. This would require effort and time that might not be available when operating in the littorals.[117]

At the tactical level, a common tactical picture (CTP) is created. Various CTPs are correlated and fused to create a new database that is then used to build the COP. However, data used to build a COP or CTP mean little without a context—that is, personal understanding of how data were developed and what their sources were. Not all available data are allowed onto the CTP, and not all data from various CTPs are allowed into the COP.[118]

One of the potentially greatest problems here for littoral combat is that operational commanders might interfere in the responsibilities of tactical commanders. It is a dangerous illusion to believe that a COP provides sufficient fidelity to allow operational commanders to make tactical decisions. They and their staffs are too far away to understand the situation better than the tactical commander on the scene of action. Moreover, even if operational commanders had precise information, they would not know the context in which information had been collected and processed. Hence, operational commanders inserting themselves into a situation would find themselves reacting to events instead of exercising proper control.[119]

CEC fuses high-quality tracking data from participating sensors and distributes the result to all other participants in a filtered and combined state using algorithms to create a single, common, air-defense tactical display.[120] The advent of CEC resulted in great improvement in the accuracy of air-contact tracking, continuity of tracks, and identification consistency.[121] CEC provides a superior air picture, based on all sensor data available, that allows considerably earlier detection and more consistent tracking of air contacts than previously possible. CEC was designed especially against the air threat in littoral waters.[122] It extracts data from sensors aboard surface ships and aircraft in a group and displays fire-control-quality data in a matter of microseconds to all so that they can engage incoming targets at maximum intercept ranges.[123] Cues based on composite tracks allow downrange ships to detect targets earlier and maintain track longer. They also allow the maximum battle space in which to engage theater ballistic missiles.[124]

Yet the networking of platforms, weapons, and sensors has a number of technical and human limitations that could adversely affect commanders and staffs in high-intensity combat in the littorals. All too often, collecting information becomes an end in itself. Too much information might be collected by higher headquarters, producing backlogs that cannot be processed or transmitted in a timely fashion to subordinate tactical commanders. At the tactical level, veritable floods of information overload users and may desensitize them.[125] The most extensively networked sensors, decision makers, and shooters can only see what an individual sensor can see. A limitation is the ever-growing communications bandwidth required to transmit the increased amount of data to decision makers and shooters as sensors are added to the network.[126] Another issue is that different decision makers at different levels may need to see different amounts and types of information. For example, air, ground, and naval component commanders would require different tactical pictures. This last is perhaps the single biggest flaw in today's network-centric environment today, and it is especially critical for littoral warfare.

A GROWING THREAT

Warfare in the littorals, particularly in narrow seas, differs in important respects from the war on the open ocean. No maritime theater is more directly affected by the geomorphologic, hydrographic, and oceanographic features of the environment than a narrow sea. Generally, the small size of the theater, short distances, the presence of a large number of islands, proximity of a landmass, the shallowness of water, and great variability and unpredictability of oceanographic conditions considerably affect the employment of surface ships, submarines, and aircraft. Although all littorals represent challenges in the employment of naval forces and aircraft, the most complex and unpredictable environment is that of the typical narrow sea.

Sea-denial capabilities of the weaker side in the littorals have been significantly increased over the past several decades. A blue-water navy, such as the U.S. Navy, underestimates or, worse, dismisses the growing threat to large surface combatants in the littorals, within global choke points, and in their approaches only at its peril. These threats are bound to increase in scope, range, diversity, and lethality in the years to come.

Among the principal prerequisites for the successful conduct of war in the littorals, perhaps the most critical is a force optimally designed for operations in confined and shallow waters. However, no single-type force, no matter how capable, can ensure success in the littorals. Forces for littoral combat should be organized differently from those for war on the ocean; specialized littoral assets should not be considered either as replacements for blue-water forces or as expendable. The lack of adequate capabilities for littoral warfare could cost a blue-water navy, such as the U.S. Navy, dearly in the case of a high-intensity conventional war. So might lack of a sound theory of littoral warfare, operational concepts, and doctrine; these require much effort and time and cannot be developed in a hurry after hostilities start. Key among the doctrinal tenets for littoral warfare is that command and control should be centralized at the operational level. However, the operational commander should apply the true spirit of the German-style mission command. Subordinate tactical commanders must be given sufficient freedom to act; they in turn must be ready to take high but prudent risks in executing their assigned missions.

NOTES

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13. U.S. Defense Dept., *Department of Defense Dictionary of Military and Associated Terms,* JP 1-02 (Washington, D.C.: Joint Staff, 8 November 2010, as amended through 15 March 2013), p. 173.
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