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Renewal of Navy's Riverine Capability: A Preliminary Examination of Past, Current and Future Capabilities

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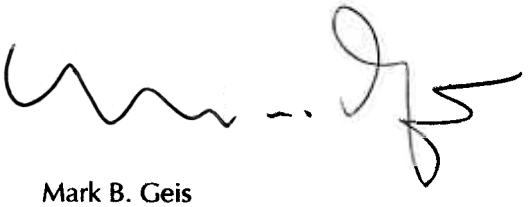

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Summary

In May 2005, the Chief of Naval Operations a formed a GWOT Working Group to support the current Quadrennial Defense Review (QDR). It identified several gaps in riverine capabilities, expeditionary support, and the Navy's ability to engage countries in foreign internal defense and security assistance. Following an outbrief to the Chief of Naval Operations, the Navy announced that it would reconstitute a U.S. Navy riverine capability and be ready to support riverine operations in Iraq in March 2007. On 1 October 2005, the Navy stood up a Navy Expeditionary Combat Command (NECC) with a prospective riverine force as one of its elements.

The Director of Deep Blue (OPNAV N3/5) asked the Center for Naval Analyses (CNA) to help the Navy define the maritime domain in which riverine operations may take place, the potential missions and tasks appropriate for a riverine force, and the resource implications related to the Navy's decision to establish a riverine capability. This report examines riverine history; defines the maritime domain as it applies to brown-water operations, identifies where riverine operations might occur; and identifies operational and functional tasks that might be employed by a riverine force. It also examines how well the U.S. Navy's projected riverine capability fits across a range of military operations.

We found that the U.S. Navy has a long and varied but episodic history of riverine operations, which are inherently joint and often combined. Ground and air combat units along with different types of naval units routinely work together. While riverine craft are usually the centerpiece of any riverine operation, they do not perform significant riverine missions by themselves. Riverine operations are also complex: they involve frequent close combat and the employment of combined arms.

In a conceptual sense, maritime domain is directly related to maritime security and extends beyond our borders to sovereign nations. We surveyed 60 countries which fall into what is known as the non-integrated Gap, where the U.S. might become potentially involved.[1] (See figure 2 on page 43.) About 1.8 billion people live in these countries, which are characterized by 201,000 kilometers of waterways and 21 river deltas. Thirty-nine of these have modest-to-extensive riverine systems or deltas—some of which are larger than the Mekong Delta, where more than 500 craft and 9,000 sailors were employed during the Vietnam War. Of the 39 countries, eight are in Asia Pacific, nine are in South America, six are in the Middle East/Southwest Asia/North Africa, and 16 in the Sub-Saharan Africa.

When riverine forces are introduced into forward operations areas within the maritime domain, several things should be considered: access may not be automatic, operating areas may be complex, and multi-service integration may be needed. Sovereign nations can delay or deny access to U.S forces. Operating areas can have several units operating in them, blurring command and control lines and situational awareness. When operational areas grow in complexity, unity of effort can only be achieved through unity of command, well-defined objectives, and simplicity.

After developing an analytical methodology to determine riverine requirements, we identified 20 of the most relevant operational tasks and several conditions that affect riverine operations. To illustrate how the analytical methodology might be used, we examined how riverine resources might support four operational tasks across a range of three military missions: security assistance, counter-insurgency

1. Countries that embrace "globalization" fall into the functioning Core. They accept content flow and possess normative rule sets that bind countries together in mutually assured dependence associated with integrating one's national economy to the global economy. All other countries fall into the non-integrated Gap [For more, see Thomas P.M. Barnett, *The Pentagon's New Road Map: War and Peace in the Twenty-first Century* (G.P. Putnam's Sons, 2004)].

(COIN)/global war on terrorism (GWOT), and major combat operation (MCO). [2]

Our preliminary analysis found that after the Navy stands up its initial capability in FY-07, it will be able to support security assistance missions, if it chooses, and that it will be able to take on area security mission currently being performed by the Marines in Iraq. It will not have a credible capability to support river control missions until it fields its full capability in FY-10. Even then, its support of an MCO will be limited by the available resources—primarily people and craft—available within its riverine force.

2. The four operational tasks are as follows: security assistance, area security, river control, and a consolidation of all highlighted operational tasks during a major combat operation.

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Introduction

The Director, Deep Blue (OPNAV N3/5), asked the Center for Naval Analyses to conduct a quick turnaround analysis that would examine a range of issues related to the Navy's decision to establish a riverine capability. In particular, we were asked to define the "maritime domain" in which riverine operations might occur; identify potential missions and capabilities within that domain; and analyze the implications for force structure, training and education, equipment, and support [1].

This report examines the history of riverine warfare, identifies the services' current capabilities for riverine operations, defines maritime domain as it applies to brown-water operations, identifies where riverine operations might occur, and identifies operational and functional tasks that might be employed by a riverine force. It also examines how well the NECC's Riverine Group's projected capability fits across a range of military operations.

Background

On 6 July 2005, as the former Chief of Naval Operations (CNO), Admiral Clark, was leaving office, he spelled out a series of actions to "expand the Navy's capabilities to prosecute the global war on terrorism." One action called for establishment of a riverine force [2].

Admiral Mullen, the current CNO, reaffirmed Admiral Clark's position, stating, "We need a fleet that can operate at the other end of the spectrum ... We need a green water capability and a brown water capability ... I want a balanced force in every sense of the word ... I believe our Navy is missing a great opportunity to influence events by not having a riverine force. We're going to have one." (See [3].)

The evolving threat

The end of the cold war changed the nature of the threats facing the United States. With the demise of the Soviet Union, massed formations of conventional forces no longer threaten the United States or our allies in Western Europe. In addition, and possibly more importantly, much of the financial support to the third-world governments from both the East and West has come to a halt. This has made it increasingly difficult for many foreign governments to suppress nationalist and religious tensions within their borders. Hence we see many failed states, which have become breeding grounds for terrorism.

When the United States was attacked on September 11, 2001, a new war began. This new war is not against a conventional army from a single hostile state but rather against an unconventional enemy operating worldwide in failed states as well as those teetering on the brink. Thus, our wartime planning construct changed dramatically. Not only did the United States need to prepare for MCO, it also needed to prepare to interdict and respond to terrorists at home and abroad. In the latter, our response options include actively engaging and partnering with other nations in matters of Foreign Internal Defense (FID), COIN, and stability operations.

When the CNO stated that he wanted a balanced force, he was referring to the changing nature of threats facing the United States and how the Navy might expand its transformational concept of Sea Power to include operating in and having command of all things maritime—from the darkest corners of ungoverned waters, to the well-sailed sea-lanes of world trade [3].

GWOT Working Group

In May 2005, a GWOT Working Group was formed to support the current QDR. This group identified six GWOT missions, 19 Navy tasks, and 107 Navy capabilities. The capabilities to meet a requirement were based on existing plans. Appendix A lists missions and tasks identified by the GWOT Working Group.

The Working Group identified Navy capability gaps in riverine operations, expeditionary support, Navy support of special operations forces (SOF), helo support of GWOT, boarding teams, maritime domain awareness, and Foreign Area Officer (FAO) presence. Of particular interest to this study, the Navy has not committed force to support basic riverine operations, such as security and force protection, interdiction, patrol, or FID training [4].

Navy Expeditionary Combat Command (NECC)

In 2005, the U.S. military leadership considered a variety of initiatives that would enable the Navy to increase its in-country contributions to Operation Iraqi Freedom (OIF), and to GWOT more generally. One of those options was to increase the Navy's presence on Iraq's rivers. In response, the Navy announced that it would reconstitute a U.S. Navy riverine capability.

Then, on 1 October 2005, the Navy stood up a NECC, with the prospective Navy riverine force as one of its elements.[3] The NECC's commander, RADM Donald K. Bullard, announced that the Navy would deploy three river combat forces of 12 boats each, manned by more than 700 sailors, with the first unit to become operational in 2007.[4] In press interviews, he declared that this force would take over the riverine missions in Iraq from the U.S. Marine Corps in 2007, but that it could also be deployed around the globe—for example, to Nigeria or Colombia.

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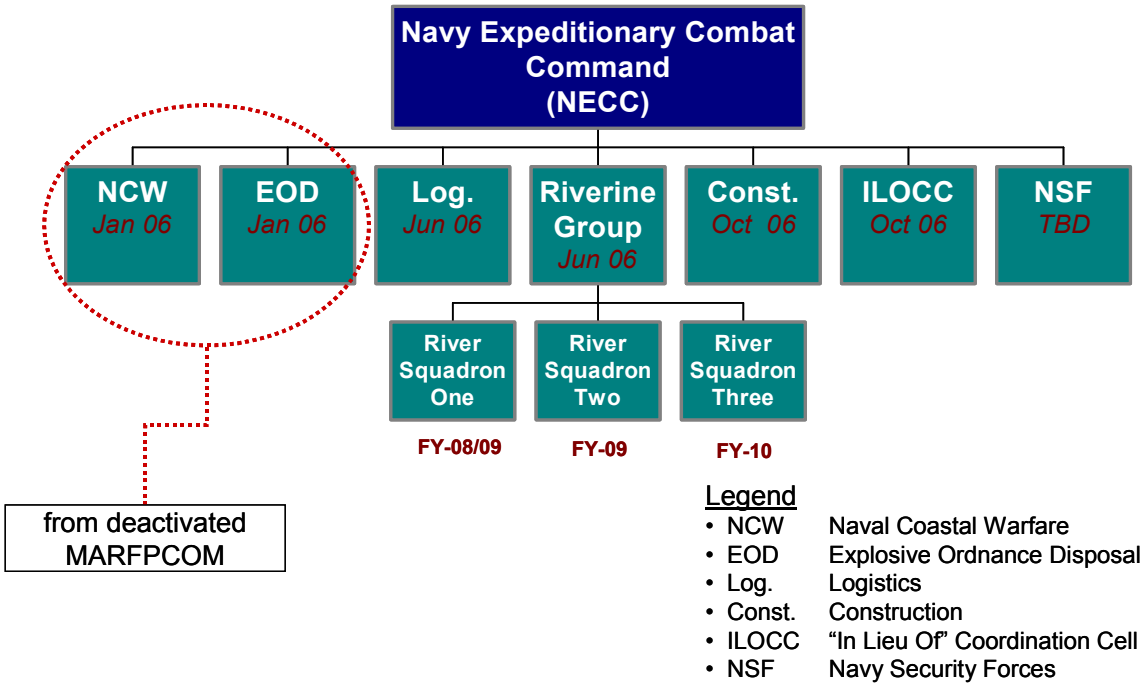
3. Other elements of this 40,000-strong command are to include naval coastal warfare (NCW), explosive ordnance disposal (EOD), mobile diving and salvage, naval expeditionary logistics support, naval construction, naval security, and other specialized naval forces—including forces currently assigned to the Maritime Force Protection Command (MARFPCOM), which itself was only recently established (on 1 October 2004).

4. In contrast, the U.S. Navy deployed six river gunboats, on the Yangtze Patrol between the world wars, each with a complement of 60; and it deployed about 450 riverine craft (and 4,500 riverine craft personnel) in Vietnam in the late 1960s.

The NECC structure, shown in figure 1, is designed to align type commander (TYCOM) functions, expeditionary resource management, and some littoral warfighting command and control (C2) under one command.

Figure 1. Organization of Navy Expeditionary Combat Command



As shown, a riverine group is being stood up within the NECC organization. It will comprise a headquarters element and three squadrons. The first squadron will become operational in FY-07. The other two squadrons will be activated in FY-09/FY-10. Each squadron will be assigned 12 riverine craft, and will be organized into 3 detachments of 4 boat teams.[5]

5. Each boat team (alpha, bravo, charlie, and delta) will be manned by two five-man crews to enable port and starboard rotation during surge operations.

The Navy has agreed with the Marine Corps that it will assume Marine Corps' riverine mission in Iraq—primarily security—in March 2007. Unfortunately, a gap is already developing as the Marine Corps stands down its riverine capability. This gap has ramifications for the combatant commanders (COCOMs) who drive current riverine requirements.

Outline of this paper

First, in the following section, we look at riverine operations from a historical perspective, highlighting major lessons learned and key takeaways. Second, we identify current capabilities across all services. Third, we define the maritime domain in which the Navy may perform riverine operations. Fourth, we examine riverine tasks and conditions (capability sets) across a range of military operations, and identify potential capability gaps. Finally, we close with a brief discussion of the "way ahead."[6]

In our final deliverable we will analyze some of the more important resource implications using a DOTMLPF framework. We'll expand our examination of future requirements, employment of riverine capabilities, development of riverine skills, and theater engagement as a component of GWOT.

6. A glossary of abbreviations and acronyms follows the appendices.

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Insights from history

In this section, we provide some important insights from history regarding riverine operations. We highlight operations during Vietnam because they provide the most recent examples of large-scale riverine operations and they also may be relevant to the Navy's current plans to renew its brown-water capability. Appendix B provides details and further historical context by tracking major riverine capabilities and operations from the Revolutionary War (1775-81) through Operation Iraqi Freedom.

The Navy legacy

The U.S. Navy has conducted operations, including combat, since its earliest days.[7] No one mission set or force construct has characterized riverine experience. On the contrary, its record has encompassed the entire gamut of riverine missions and tasks—river assault, protection of lines of communication, security operations, river crossings, operations other than war, theater security cooperation, and homeland defense.

7. The most useful comprehensive reference on the U.S. Navy's riverine experience is R. Blake Dunnavent, *Muddy Waters: A History of the United States Navy in Riverine Warfare and the Emergence of a Tactical Doctrine, 1775-1989*, Ph.D. dissertation: Texas Tech University, May 1998). A less useful abridged version, which omits much of the data and analysis on doctrine and post-Vietnam developments is *Brown Water Warfare: The U.S. Navy in Riverine Warfare and the Emergence of a Tactical Doctrine, 1775-1970* (Gainesville, FL: University Press of Florida, 2003). The most useful reference on the development of U.S. Navy riverine craft is Norman Friedman, *U.S. Small Combatants, Including PT-boats, Subchasers, and the Brown-Water Navy: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1987).

U.S. Navy riverine operations have varied in their scale and physical environment. Some operations have used only two sailing craft; others have used several hundred ships, craft and aircraft. Additionally, the U.S. Navy has operated at various times on many of the great river systems of the world and in tropical, temperate, and dry climates.

A shared history

The Navy has seldom conducted riverine operations alone. The U.S. Army, the U.S. Coast Guard (USCG) and its predecessors, and various state and militia forces have often been involved, both to provide capabilities lacking in the Navy and to add to Navy capabilities. History is replete with examples dating back to the American Revolution. Many examples come from the Vietnam War. Some come from the last decade. For example, Army Engineers bridged the Sava River using riverine craft in Bosnia, in 1995–96. Today, they routinely conduct river patrols using Bridge-Erection Boats (BEBs) in Iraq.

The USCG has a capability to conduct riverine security operations on American domestic rivers. It has provided waterborne law enforcement training to foreign riverine forces, both at its facilities in the United States and on foreign rivers. The USCG's experience in Vietnam was extensive. It mainly conducted coastal operations, but it also deployed 82-foot patrol boats (WPBs) into rivers and canals as part of Operation SEALORDS (Southeast Asia Lake, Ocean, River, Delta Strategy) in 1968. During the 1980s and 1990s, the USCG deployed to Bolivia, to train the Bolivians in boat search and registration procedures. In 2003–04, the Coast Guard surveyed and reset buoys in the mouths of navigable Iraqi rivers.[8]

8. For more information on the U.S. Coast Guard in Iraq, see Basil Tripsas, Patrick Roth, and Renee Fye, *Coast Guard Operations During Operation Iraqi Freedom*, CNA Research Memorandum D0010862.A2/Final, October 2004.

An episodic history

Although the Navy's record of riverine operations has been long, it has not been continuous. The Navy has conducted numerous riverine campaigns since the American Revolution, in general the forces have been quickly disbanded following each conflict. Maintenance of a peacetime "riverine fleet" has seldom received funding when post-war naval budgets have contracted. When a new riverine requirement has emerged, new forces usually have had to be developed from scratch.

Fortunately, the Navy's record of riverine adaptability has been good. The Navy's personnel and acquisition systems have generally been able to recruit and train riverine sailors in short order, and provide them with suitable craft and equipment. Tactics developed under fire have been quickly assimilated.

The Vietnam episode

The Vietnam War was the most recent major episode in the history of U.S. Navy riverine operations and the one most relevant to the Navy's current plans. This relevance derives from:

- The wide variety of riverine operations conducted and the plethora of specialized craft deployed, which illustrate today's choices
- The important role played by aviation and support assets, both afloat and ashore
- The co-existence of a U.S. Navy riverine advisory effort designed to improve an indigenous riverine capability—comparable to the international security cooperation programs envisioned today
- The example of significant joint operations and joint command and control issues
- The record of U.S. Navy in-house riverine craft design capabilities
- The current availability of Vietnam riverine-force veterans to provide advice, insight, context and expertise.

The Vietnam experience also provides us some insight into the magnitude of major combat operations in a riverine environment. From 1965 to 1971 the U.S. Navy deployed task forces with more than 500 riverine craft, helicopters, and fixed-wing aircraft, supported by both on shore and afloat bases, on the inland waterways of South Vietnam. During peak operations in 1971, over 9,000 sailors were in direct support of riverine operations while another 22,500 were in indirect support.

Initial missions and tasks

These forces engaged in five general mission areas: river assault, river patrol, river minesweeping, special operations support, fire support and interdiction of the enemy supply network. The craft associated with each mission area are described in appendix B.

River assault

Units of armored craft were organized into Task Force (TF) 117 to support soldiers of the U.S. Army's 9th Division in the Mekong Delta region, as part of an integrated Army-Navy Mobile Riverine Force (MRF). These craft (totalling about 200) performed transportation, command and control, fire support, medical evacuation, and other functions.

River patrol and control

In 1966, landing craft (LCPLs)—obtained from U.S. amphibious forces—and new fast 30-foot-long armed (but unarmored) fiberglass patrol boats (PBRs) were separately organized into River Patrol Force (TF 116) to patrol the extensive river and canal system of the Mekong Delta. The primary mission of this force was to keep supply routes open for South Vietnamese, U.S., and other allied forces while denying the use of the waterways to the Viet Cong.

Between 1968 and 1970, a smaller patrol operation, Task Force Clearwater, used PBRs, minesweepers, and some river assault craft to secure riverine lines of communication (LOC) and supply for U.S. Army and Marine forces operating in the northern part of South Vietnam.

River minesweeping

Starting in 1965, the Navy deployed modified 83-foot shallow-draft amphibious-assault minesweeping boats (MSBs), modified minesweeping LCMs (MSMs), and other minesweeping craft to Vietnam. MRF assault-support patrol boats (ASPBs) were rigged for minesweeping as well. They countered efforts by Viet Cong sappers[9] and swimmers to mine South Vietnamese waterways and the warships and merchant ships using them. This was especially vital in the Long Tau shipping channel from the sea to Saigon, through which passed much of the war material needed by the U.S. Army, U.S. Air Force, and South Vietnamese forces.[10]

Special operations support

In 1962 the Atlantic and Pacific Fleets each stood up new Naval Operations Support Groups (NOSGs) as part of their amphibious forces, and assigned traditional underwater demolition teams (UDTs), sea-air-land (SEAL) teams, and small-craft units to support them. In 1964 the Pacific Fleet NOSG stood up Boat Support Unit One, which—as part of its Vietnam mission set—came to use small, relatively stealthy riverine craft to covertly insert and extract SEALs and other special operations forces that were carrying out raids, ambushes, intelligence gathering, seizures, and other special operations, and to provide

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9. Sappers were enemy raiding parties with small arms, machine guns, shape charges, etc. Their purpose was to penetrate a defensive position and place explosives on high-value targets (HVTs).

10. In 1966, U.S. Navy riverine minesweeping forces in the Delta were organized as Mine Squadron 11 Alpha (redesignated Mine Division 112 in 1968). On U.S. Navy riverine minesweeping operations in Vietnam, see Tamara Moser Melia, *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777-1991* (Washington, DC: Naval Historical Center, 1991), 92-95; Murland W. Searight, "Prepare to Sweep Mines . . .," U.S. Naval Institute *Proceedings* 96 (January 1970), 55-59; George R. Kolbenschlag, "Minesweeping on the Long Tau River," U.S. Naval Institute *Proceedings* 93 (June 1967), 90-94; and "Radio-controlled Drone Boats Used in Vietnam Minesweeping," U.S. Naval Institute *Proceedings* 96 (February 1970), 123-4.

them with fire support.[11] These craft included the Strike Team Assault Boat (STAB) and other craft.[12]

Fire support from the rivers

In areas where the rivers could accommodate them, U.S. Navy "blue-water" naval forces could and would often penetrate inland, chiefly to bring their heavier weaponry to bear. For example, the 165-foot Asheville-class patrol gunboats (PG)—drawing 10 feet of water and mounted with 3"/50 (7.62 centimeter) guns—were so used where practical, especially in the Cua Lon River in support of "Seafloat" (see below). River ports such as Saigon could even accommodate cruisers.

Consolidated missions and tasks

In 1968, the then-commander of the U.S. Naval Forces Vietnam (COMNAVFORV), Vice Admiral Elmo R. Zumwalt, Jr., instituted Operation SEALORDS.[13] Zumwalt recombined and coordinated the various task forces under his command into new mixed groups (TF 194) spread out across the Delta from just north of Saigon to the Gulf of Thailand, in an effort to block Viet Cong supply movements into South Vietnam from Cambodia. Zumwalt added to the riverine force mix the PGs, 50-foot PCF ("Swift") boats, 82-foot Coast Guard WPBs, Coast Guard Boston Whaler "skimmers," and other coastal patrol craft that had heretofore been used principally in the Coastal Surveillance Force (TF 115), for "Operation Market Time" inshore coastal patrol, not riverine operations.[14]

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11. In 1968, the NOSGs were re-designated as Naval Special Warfare Groups (NSWGs), still integrally attached to the Navy's fleet and type command structures.

12. On U.S. Navy Boat Support Units, see Kevin Dockery, *Navy SEALS: A Complete History from World War II to the Present* (New York: Berkley Books, 2004), Chapter 23, "Boat Support," 554-9.

13. On SEALORDS, see LCDR William C. McQuilkin, USN, *Operation Sealords: A Front in a Frontless War: An Analysis of the Brown-Water Navy in Vietnam* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1997); and Schreadley, *From the Rivers to the Sea*, Chapters X, XII and XVII-XX.

Supporting elements

We mentioned earlier that over 22,500 personnel were in support of the riverine forces afloat. Aviation and logistics played a big role here.

Aviation

Aviation supported the MRF with surveillance, fires, and other tasks. The U.S. Navy initially borrowed Army Huey helicopters and their aircrews and was later assigned its own Army-trained aircrews from helicopter (cargo) HC–1. In April 1967, the Navy commissioned a dedicated riverine air support helicopter squadron (light): HAL–3 (Seawolves).[15] They were based ashore and on logistic support vessel (LST) "mother ships" in the Delta. By 1969, almost three dozen helicopter gunships were assigned to HAL–3 to support riverine operations. Also in 1969, the Navy borrowed 16 OV–10 aircraft ("Black Ponies") and deployed to them to Vietnam with Navy crews, as attack squadron (light) VAL–4. [16]

Logistics

Logistics support for the riverine forces was a major consideration from their inception. Bases were created ashore and afloat. Dozens of active and mothballed amphibious ships were extensively modified and sent to Vietnam to provide a number of functions: command and

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14. On the Navy's use of U.S. Coast Guard patrol boats, their organic small boats, and other small craft in riverine operations in Vietnam, see Alex Larzelere, *The Coast Guard at War: Vietnam, 1965-1975* (Annapolis, MD: Naval Institute Press, 1997), especially Chapter V, "Patrolling the Delta," 68-88; and LT J. F. Ebersole, USCG, "Skimmer Ops," U.S. Naval Institute *Proceedings* 100 (July 1974, 40-6).

15. Recent discussions of helicopter support for riverine operations in Vietnam are in CAPT Richard Knott, USN (Ret.), *Fire From the Sky–Seawolf Gunships in the Mekong Delta* (Annapolis, MD: Naval Institute Press, 2005); and CDR David G. Tyler, USNR, "Seawolves Roll in Across the Mekong Delta," U.S. Naval Institute *Proceedings* (January 2002), 45-9.

16. The Navy decided to employ fixed-wing riverine close air support aircraft as well, for their faster response times, larger payloads, and lower vulnerability.

control; messing, berthing and recreation; supply, maintenance, and repair; aviation support; and naval gunfire support.

Two U.S. Navy Mobile ATSBs were deployed during the war. Over time, the Navy moved some of its afloat riverine logistic functions ashore partly due to difficulties in coping with wind, river currents, and heavy seas, and partly in order to prepare to leave the South Vietnamese Navy with a shore infrastructure that it could easily maintain. The afloat logistic forces also were subject to swimmer, sapper, mining, and rocket attacks.[17] Nevertheless, riverine "sea basing" was a valuable operational concept throughout the war, as it gave giving riverine logistics support forces the mobility they needed to shift location along with the operating areas of the boats that they tended.

The post-Vietnam lull

This period following the Vietnam War is marked by organizational transformation and the stand-down of the Navy's conventional riverine capability. Because the Navy didn't consider riverine warfare as one of its core competencies, it decommissioned most of riverine craft, including HAL-3 and HAL-4. The remaining capability transferred to the special warfare community. But, despite a lack of progress in other dimensions of riverine warfare, riverine tactical doctrine continued to slowly evolve, as doctrine writers sought to codify the lessons learned from Vietnam.

The Worthington Study

In August 1990, the Navy/Marine Corps Board tasked RADM George Worthington, Commander, Naval Special Warfare Command (NAVSPECWARCOM), to develop a training and operational concept to field and exercise a battalion-size riverine assault capability from existing USN force structure. In December 1990, in coordination with the U.S. Atlantic and Pacific Fleets, NAVSPECWARCOM published its findings [5]. The study advocated that the Navy and Marine Corps develop joint training and operational concepts to

17. For example, in 1968 Viet Cong sappers attached mines to the hull of USS *Westchester County* (LST-1167). The detonation killed 26 men. The ship, however, returned to duty off Vietnam soon thereafter.

field a riverine assault capability from within their existing force structure. That structure comprised a MRF command element, a battalion-sized Marine air-ground task force (MAGTF), and a River Assault Group (RAG). The new MRF would comprise of waterborne, aviation, ground, combat support, and combat service support elements. In total this force would consist of about 3,000 personnel and 75 craft. The USN craft are listed in table 1.

Table 1. Navy riverine, landing and ferry craft

Craft	Lift	Mission	Draft (feet)	Qty
Landing Craft, Utility (1600), LCU	189 tons, 400 pax	C2, logistics	9	4
Landing Craft, Mechanized, LCM-8	60 tons, 200 pax	Lift, re-supply, MCM, re-fueler	5.25	12
Mini-Armored Troop Carrier, MATC	4,400#, 15 pax	Troop carrier		14
Patrol Boat, Rigid, PBR	4 crew members		Shallow	10
Patrol Boat Light, PBL	3 crew + SEAL team,	Special warfare	1.5	3
Causeway Section, Non-Powered, CNSP	Ferry material and supplies	Floating base	4	27
Side-Load Warping Tug, SLWP	Can be used to ferry material and supplies	Construction of CSNP	4	5

The Marine Corps would provide rotary- and fixed-wing aviation and 12 Amphibious Assault Vehicles (AAV).

The bill for this proposed force was more than the Navy and Marine Corps thought feasible, given the increasingly constrained post-Cold War defense budgets and tumbling fleet force levels. The Navy's late Cold War battle force of almost 600 ships was already shedding 30 ships a year, and the Navy was hard pressed to form a riverine force with an uncertain future.

Throughout the 1990s, the Navy periodically revisited the Worthington Study. Each time, however, it ultimately backed away from re-embracing riverine operations, which it saw as a low-priority mission area in a climate of scarce defense dollars and numerous competing requirements.

Thus for more than 30 years after the Vietnam War, including more than a dozen years after the Cold War, the Navy ignored riverine operations almost totally. Instead, it was content to allow the U.S. Special Operations Command (USSOCOM) and NAVSPECWARCOM to maintain (and pay for) a small, specialized, unconventional riverine capability, and to allow the Marines to acquire their own small riverine force.

Key takeaways

We find at least ten key, bottom-line takeaways in examining the U.S. Navy's riverine history:[18]

- U.S. Navy riverine operations have a long history. There is nothing "un-Navy" about riverine operations.
- These operations have encompassed the entire range of riverine missions, including riverine assault, patrol, interdiction, counter-insurgency, operations other than war, and security cooperations and assistance.
- The Navy has shown that it can, in fairly short order, field a wide variety of riverine forces, in all sizes. It has a range of riverine capabilities, from using organic ships' boats and landing craft to penetrate small rivers, to deploying massive armadas of specialized riverine craft.
- Riverine environments vary. While the U.S. Navy has operated on many of the world's rivers, it lacks experience operating on others.
- Riverine operations are inherently joint, and are often combined. The riverine environment is one in which ground and air combat units—as well as naval units—routinely operate, as do indigenous para-military and military forces. Joint and combined command and control and interoperability issues are salient.

18. Appendix B provides further context and support for these key takeaways.

- At no time have riverine operations been the most important mission set of the U.S. Navy. They have always co-existed—and competed for resources—with other forward sea control, power projection, and naval presence missions being planned or conducted simultaneously.
- While combat riverine craft are usually the centerpiece of any riverine operation, they cannot carry out any significant riverine missions by themselves. Any new U.S. Navy riverine operational concept must include built-in close air support for surveillance and fires and robust logistic support to augment the inherent small carrying capacity of the craft.
- The Navy's operational and organizational riverine history has been episodic, rather than continuous. Periodically starting from scratch—as in 2005–2006—has been the norm.
- Since World War II, the Navy has maintained a more or less continuous riverine craft design capability within Naval Sea Systems Command (NAVSEASYSCOM) and its predecessor organizations, a capability that can be quickly drawn upon.
- During the 12 or so years, the institutional Navy has largely ignored riverine operations. Nevertheless, the U.S. Marine Corps and USSOCOM developed and maintained systems and doctrine that kept American maritime riverine warfare concepts alive. So too did a handful of academics, and a small cadre of serving Navy officers conducting research in Monterey and Fort Leavenworth. The Coast Guard, Army Engineers, Marine Small Craft Company (SSCo), and special boat teams (SBTs), as well as the Naval Small Craft Instruction and Technical Training School (NAVSCIATTS) staff have developed and assimilated "lessons learned" from recent combat operations on South American and Iraqi rivers. Thus there now exists a firm, documented base of recent military and naval thinking on which to build new U.S. Navy riverine concepts of operation.

Marine Corps legacy

In 1989, the Marine Corps began an effort to build a riverine capability in support of the U.S. Marine Corps (USMC) Colombian Riverine Program and to re-establish the Department of Navy (DoN) conventional capability.

After the Vietnam War, when the Navy divested itself from conventional riverine forces, the Marine Corps was faced with the choice of either developing its own capability or having none. At this time the Corps had a small craft capability resident within both I Marine Expeditionary Force (MEF) and II MEF, which were maintaining small squadrons for employment by the Marine Expeditionary Units (MEUs). These craft were designed solely for troop transport and not for riverine operations.

In 1991, the Marine Corps began acquiring river assault craft (RAC), and established a RAC platoon under Headquarters Battalion, II MEF [6]. This initial effort provided craft and structure, but little else. Thus, the RAC platoon was hampered by poor procurement practices, logistical support, career development, and assignment practices [7].

In 1992, the Marine Corps initiated several improvements by consolidating its assets and personnel into a new unit, the SCCo. While this was a significant advancement, the new unit was still under-resourced until 2001, when equipment and manning problems were finally resolved. This resolution was marked by the introduction of the Small Unit Riverine Craft (SURC) in 2001, construction of the Court House Bay facility in 2002, as well as improved staffing and logistical support.

In September, 2004 CMC approved the Force Structure Review Group (FSRG) recommendation to stand-down the SCCo. The FSRG was tasked by the Commandant of the Marine Corps (CMC) to review Marine Corps force structure and make recommendations to best position the Marine Corps to meet its GWOT responsibilities. The

SCCo was identified by the Review Group as a low demand unit and a source for manpower to establish new higher demand units [8].[19]

For greater detail and historical context, see appendix C.

Theater engagement in South America

The Andean Initiative—a component of the U.S. counter-narcotics strategy introduced by the first Bush administration in 1989—was the catalyst for renewed national interest in riverine operations and brought about the USMC Colombian Riverine Program [9]. The objective of the policy was to stem the flow of cocaine into the United States, with a focus on Colombia, Bolivia, Ecuador, and Peru [10, 11].

Training teams and seminars

The Marine Corps initiated a riverine training program in South America, which initially focused on the goal of creating a self-sufficient Colombian Marine (COLMAR) riverine force [12]. Later, the program expanded to other South American countries. In Colombia, the program called for the development of riverine combat elements (RCEs) [13] as well as other U.S. assistance to the COLMAR [14]. This program—which is changing today—developed Mobile Training Teams (MTTs) and, later, Riverine Training Teams (RTTs), to instruct the COLMAR in riverine operations. The final piece of this USMC program included on-site riverine seminars, in which Riverine Operational Seminar Teams (ROSTs) work with senior Colombian officers [9] and Joint Planning Assistance Teams (JPATs) act as liaisons with host nations. Since the program's inception, RTTs and ROSTs have interfaced with Argentina, Bolivia, Ecuador, Honduras, Guyana, Panama, Paraguay, Peru, and Venezuela [15, 16].

19. New active duty units recommended by the FSRG included: two infantry battalions, three light armor reconnaissance companies, three reconnaissance companies, two force reconnaissance platoons and one air and sea gunfire liaison company. New reserve units recommended by the FSRG included: one anti-terrorism battalion, two light armored reconnaissance companies, one intelligence support battalion, and augmentation of a variety of critical military occupational skills (MOSs) such as psychological operations (PSYOPS), EOD, human intelligence (HUMINT) and civil affairs.

Training areas include small boat maintenance and repair, logistics operations and systems, and basic coxswain skills, as well as training in immediate action drills and combat operations. Generally speaking, the Marines are prohibited from engaging in force-on-force operations, often by a foreign country's constitution.

While the riverine training in South American is still sourced by the Marines, the USMC reservoir of riverine expertise is drying up quickly.[20] This means that as the Navy assumes the riverine role, it must quickly develop expertise in order to fill the developing void.

Escort operations in Panama

From 1995 until the U.S. withdrawal in 1999, SCCo provided rotating detachments to the Panama Canal in order to escort high-value U.S. shipping and nuclear submarines transiting the canal [17].

Operations in Iraq

During OIF the SCCo performed various waterborne tasks, both day and night, with and without the ground combat element (GCE) embarked. They also conducted over-land convoy operations to a river landing site, providing their own intelligence estimates and security enroute as well as during launch and recovery. The SCCo had regular, direct enemy contact and engagement during the conduct of the following waterborne tasks:[21]

- Performed reconnaissance and surveillance
- Conducted combat patrol

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20. Military Groups within South America nominate training requirements to Marine Forces South (MARFORSOUTH)—mostly related to counter-drug operations—which are then passed directly to Marine Forces Atlantic (MARFORLANT) and II MEF for support. Capabilities within the Marine Corps are decreasing as it stands down its capability. Currently, there are fewer Marines currently available within II MEF to conduct exercises, RTT, or ROSTs.

21. These tasks often required extensive integration with the supporting and supported forces as well as a wide range of organic capability.

- Performed waterborne troop movement (overt/covert, insert/extract), waterborne guardpost, waterborne quick-reaction force (QRF), and observation post
- Conducted a hydrographic survey and bridge site survey
- Performed counter-improvised explosive device (IED) ambush
- Conducted island clearing (search and destroy of enemy weapon caches)
- Performed search and recovery
- Provided sealing/denial of waterways
- Provided flank screen for GCE movement
- Formed outer cordon for GCE cordon and search
- Provided direct fire support
- Provided radio relay
- Conducted fixing, blocking, disruption, suppression, and feints.

The SCCo was able to execute many of these missions based on its resident intelligence analysis, mission-planning expertise, and organic infantry skills. Because many GCE commanders were unaware of the SSCo's capability, they initially had to actively seek missions for themselves and aggressively pursue their desire to be assigned as mission participants. But as the operation progressed, they were requested with greater frequency as they became known as the only providers of a credible and needed riverine capability. Additionally, their participation was based on a higher headquarters' understanding that they were a self contained combat arms unit that operated small craft. This is a critical distinction because when they were tasked or when they initiated action, they naturally worked into the ground combat scheme of maneuver and could conduct combined arms maneuver warfare capably. They were able to pursue the enemy and respond to attacks during the conduct of any mission with their own organic personnel, weapons, and tactics. They also were able to effectively coordinate with adjacent and supported units, as required. This is to say

that the SSCo was a complete combat unit, not just the owners and operators of small craft.

Key takeaways

The Marine Corps' involvement in developing and maintaining a riverine capability since 1989, as well as their recent experience in Iraq, yields the following nine key takeaways:[22]

- The requirement for a credible riverine capability has been clearly established for many years. Recently this has been stated in not only the Worthington study, but in numerous CMC and Marine Corps Combat Development Center (MCCDC) documents as well [5, 18, 19].
- It is impossible to have a useful riverine force without adequate resources and support in both manning and equipment.
- The Marine Corps recognized the importance of riverine operations and took the initiative to maintain a capability when the Navy was divesting. But, even in the Marine Corps, riverine operations remained a niche with no strong, consistent institutional support. The Navy has a small craft community already in place and as it consolidates under the NECC, it should be able to avoid this problem.
- Even in a desert country (Iraq), a riverine capability has many uses and is multiplier of combat power. It provides a capability that is unique and needed.
- Riverine operations are not just a matter of operating and maintaining small craft. They are complex combat operations that may involve frequent close combat. This requires the small-craft unit to have resident combined-arms maneuver-warfare expertise.
- USMC theater engagement in South America is well established, but with the disbanding of the SCCo, the USMC reservoir of expertise is dissipating. In the future, we see the Marine

22. Appendix C provides context and support for these key takeaways.

Corps focusing on ground combat training and the Navy focusing on waterborne training, which will require a rapid "ramp up" by the Navy's riverine force.

- The enemy reacts quickly to a riverine force's presence. Therefore, if the force does not have the capability to maintain battlespace dominance, it will have limited influence and be forced to rely on tactical agility and surprise to remain effective.
- The SCCo had both resident combine-arms maneuver-warfare expertise and a natural place within the MAGTF. The new Navy force will be challenged on many levels to integrate in an operational environment that is new to it. It will be especially critical for the force to develop meaningful relationships with the various ground combat units that will embark on its small craft. In the long term, this will require maintaining an aggressive exercise schedule. In the near term, such a relationship must be developed in pre-deployment and in-theater training.
- If the Marine Corps loans or transfers their SURCs to the Navy as is currently envisioned, the Marine Corps may not be able to support current Marine Special Operations Command (MARSOC) plans or establish a reserve riverine capability without significant capital outlays. That said, if the Navy develops a riverine capability, the Marine Corps may not need a riverine capability within its reserve component.

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Where we are today

The Navy is coming out of the post-Cold War to engage our nation's newest threat—insurgents and transnational terrorists—in OCONUS riverine environments. The Chief of Naval Operations is repositioning the Navy to engage other countries (in security cooperation and assistance) and to operate in the littorals—both brown and green water [20]. This rudder change is timely because the Marine Corps is divesting its riverine capability as the Navy prepares to assume USMC missions in Iraq in March 2007.

This section highlights current service capabilities. We examine what assets the services have and how they might use them.

Service capabilities

Even though the Navy is developing a relatively small group of Navy personnel to flesh out the Riverine Group, it will also be able to increase its riverine capability by employing resources from other naval commands.

Additionally, throughout this process, the Navy will not be alone in a riverine environment. The Army and Marine Corps will continue performing their riverine missions, and the USCG will remain in the Iraqi littorals.

Navy

The Navy does not have a dedicated riverine capability. NAVSPECWARCOM's Special Boat Team (SBT)–22 and NAVSCIATTS are SOCOM assets.[23] That said, other Navy elements also possess small craft capable of riverine operations; however, tasking them is problematic because they are neither optimized nor trained for

23. SBT-22 also has a detachment based in Sacramento, California.

such tasks, and their use in rivers would preclude them from performing their primary missions. These elements include amphibious forces, the coastal forces, and the construction forces.

NAVSPECWAR riverine capabilities

Both SBT-22 and NAVSCIATTS are based at the Stennis Space Center in Bay St. Louis, Mississippi. SBT-22 specializes in riverine operations and is manned by both active and reserve personnel. Its specialty has been operations in Latin America, but it has global capabilities. NAVSCIATTS trains foreign sailors in riverine craft and equipment operations and maintenance, including command, tactics, and engine and weapons operation and maintenance. Its focus has been on the Caribbean and northern South America, but it too has become globally capable. NAVSCIATTS deploys MTTs for in-country training of foreign forces.

Naval Special Warfare riverine craft

Special Operations Craft Riverine (SOCR): In 2002, deliveries of the Navy's newest riverine craft began. The SOCR is 33 feet long and has a 2-foot draft—less at speed. Its maximum speed is 40 knots, and it has a 195-nm range. Additionally, it has five weapons mounts, an aluminum hull, and can carry up to 20,000 pounds of cargo.

Patrol Boat, Light (PBL) (Boston Whaler): This craft is 25 feet long with a 1.5-foot draft. It can go 35-40 knots maximum and has a 240-nm range at 30 knots. It is small and unarmored with a small payload capacity, but is highly maneuverable. It is used by NAVSCIATTS to train foreign navies.

Mini-Armored Troop Carriers (MATC): This craft is 56 feet long with a 2-foot draft. It can go 35 knots maximum and has a 135-nm mile range at 35 knots. Developed from Vietnam lessons-learned, it has a low radar signatures, quiet engines, internal jet pumps, aluminum hull, ceramic armor, flat bottom, and seven weapons points. It can carry two tons of cargo and is C-5 transportable.

Other naval special warfare craft

Mark V Special Operations Craft: This is a 82-foot craft with a 5-foot draft and is not optimized for riverine operations. It is intended to support

SEAL operations in medium- and low-threat areas and was first deployed in 1995.

Rigid-Hull Inflatable Boats (RHIBs): These are 35-foot armed boats with a 3-foot draft, used for SEAL operations. They were first deployed in 1997 and are not optimized for riverine operations.

Navy riverine doctrine and TTPs

The current overarching Naval Special Warfare doctrine makes almost no mention of riverine operations. See, for example, Naval Special Warfare, NWP 3-05 (Rev D), (Newport, RI: Naval Warfare Development Command, January 2000). However, the appropriate tactics, techniques, and procedures (TTPs) are in NSW/USMC Riverine Operations Handbook, Tactical Memorandum (TACMEMO) XL 0080-01-93 (San Diego, CA: Naval Special Warfare Center, February 1993.)

Amphibious forces

As they did in the Vietnam era, the Navy's amphibious forces include landing craft that can, if necessary, operate in some riverine environments, by virtue of their inherent shallow draft. These include principally:

- *Landing Craft Air Cushion (LCAC)*: A 135-foot craft with negligible draft on cushion.
- *Utility Landing Craft (LCU-1600)*: A 135-foot craft with an 8-foot draft. It can lift 180 tons or carry 400 combat equipped Marines.
- *Mechanized Landing Craft (LCM-6)*: A 56-foot craft capable of 9 knots with a 4.25-foot draft. This was a mainstay of the Vietnam War. It can lift about 34 tons or carry 80 combat-loaded troops.
- *Mechanized Landing Craft (LCM-8)*: A 74-foot craft capable of 12 knots with a 3.5-foot (light) and 5.0-foot (heavy) draft. It can lift about 47 tons or carry 200 combat-loaded troops.

- *Landing Craft Vehicle and Personnel (LCVP)*: A 36-foot craft.
- *Landing Craft Personnel (LCPL)*: A 36-foot craft with a 3.8-foot draft.

Navy inshore boat units

Navy Inshore Boat Units (IBUs) provide seaborne protection to ports and harbors, often working in tandem with land-based Mobile Inshore UnderSea Warfare (MIUW) units. IBUs were formerly manned by reservists only, but the Navy has recently stood up active units as well. IBUs deploy shallow-draft armed harbor patrol craft in the 25 to 35 foot range that could operate in some riverine environments if required. Many IBU sailors are combat veterans of IBU deployments to OIF, where they protected Gulf ports and oil installations.

IBUs and MIUWs make up the recently established Naval Coastal Warfare Squadrons (NCWRONs), which, in turn, are components of the Navy's Naval Coastal Warfare Groups (NCWGs). The NCWGs now report to the MARFPCOM and, along with the Navy's new Riverine Group, will soon report to the NECC.

Mobile security squadrons

These active-duty squadrons, part of the MARFPCOM, deploy air-transportable armed 25-foot harbor patrol boats to augment security for forward U.S. Navy units, especially during port visits. These craft could be pressed into riverine service if needed.

Patrol coastal (PC)

In the years after the Vietnam War, the Navy's coastal forces fared somewhat better than its riverine forces, due to the need to maintain littoral patrol and harbor defense capabilities. Today's thirteen 170-foot patrol coastal boats (PCs) evolved from the Vietnam-era's patrol gunboats (PGs), fast patrol craft (PTFs), fast patrol craft (PCFs) and a variety of now-retired patrol hydrofoil ships and craft. The PC could be used in riverine operations in the same way that the Asheville-class PGs were employed during Operation SEALORDS in South Vietnam. They draw about 8 feet.

Construction forces

The Navy's Construction Battalions (Seabees) have some small craft in their inventory, principally to support amphibious operations. Seabees have already deployed to Vietnam and South America to construct advanced riverine floating and riverside shore bases.

Combat craft engineering

The U.S. Navy maintains its design and use of small craft. Following the Vietnam War, the Combat Craft Department (CCD) of NAVSEASYSCOM kept the U.S. Navy's river craft program alive. Its naval architects and engineers assimilated wartime lessons learned and designed several generations of combat river craft. They supported the development of combat riverine craft throughout the 1990s and, most recently, the fielding of NAVSPECWARCOM's Special Operations Craft Riverine (SOCR) and the U.S. Marine Corps' SURC.

Marine Corps

The Marine Corps is currently supporting riverine operations in Iraq. It primarily does so by providing dam security, but has been engaged in other missions as outlined earlier. It is planning to stand down this capability in March 2007. Equipment loans and transfers are being negotiated at the time of this report.

As the Marine Corps stands down its riverine capability, it will no longer train foreign militaries on the water side of riverine operations. RTTs are being replace by Landing Attack and Subsequent Operations (LASO) teams; ROSTs are being replaced with Combined Operations Seminar Teams (COST).

Amphibious raiding craft

The MEU(SOC)s generally designate one of their battalion landing team's (BLT's) infantry companies as a boat company in order to perform amphibious operations—primarily raids—using the combat rubber raiding craft (CRRC). Since the CRRC has no combat or communication systems, it is used simply as a mode of transportation. MEU(SOC) boat companies on the West Coast and in the Western Pacific receive basic coxswain, maintenance, and navigation training locally at the Expeditionary Warfare Training Group (EWTG),

Pacific, or III MEF Special Operations Training Group (SOTG) in Okinawa prior to deployment, as part of the normal MEU(SOC) work-up.[24]

Reconnaissance craft

Both Division and Force Reconnaissance use the 5-meter RHIBs and CRRC for waterborne movements. Their coxswain training is performed as needed, either internally or with their resident EWTG.[25]

U.S. Coast Guard

Special Missions Training Center (SMTC)

In April 2003, the Navy and Coast Guard agreed to consolidate certain Navy-wide anti-terrorism and force protection (AT/FP) training at Camp Lejeune, North Carolina, to enable more effective integration of Navy and Coast Guard forces. The agreement supports consolidation of common training—mainly coxswain—and standardization of TTPs, leveraging each service's strengths and core competencies [21].

The Coast Guard trains its Port Security Units (PSU), and other units, at the Special Missions Training Center (SMTC), where they receive fast boat training. The Navy and Marine Corps train coxswains and receive specialized training on crew-served weapons at the Center.[26]

The SMTC also has the capability to organize and deploy MTTs when requested by COCOMs.

As the Navy stands up its riverine capability, the agreement between the Navy and Coast Guard may change. In the foreseeable future, however, USMC units must rely upon the SMTC for riverine training

24. Prior to 2003, II MEF SOTG trained boat companies on the East Coast.

25. In 2003 the East Coast MEU(SOC)s stopped maintaining a small craft capability, so II MEF SOTG ceased small craft training in 2002.

26. The SMTC was formerly known as the Riverine Training Center. Instructors from the Navy, Marine Corps, and Coast Guard support SMTC.

as long as they are providing dam security units (DSUs) and performing other riverine missions in Iraq.

Port Security Unit

The Coast Guard has eight PSUs, mainly manned by reserves. Each PSU is outfitted with six Transportable Port Security Boats (TPSBs)—a 25-foot Boston Whaler with a 1.5-foot draft [22].

PSUs conduct OCONUS port security in support of the regional COCOMs. They normally attach to an NCWG and provide waterside protection to key infrastructure and HVTs. These units have been deployed around the globe and have the ability to support riverine operations.

Other Coast Guard craft

The U.S. Coast Guard has an array of other craft listed below that could be used for riverine operations under special circumstances [23]. The U.S. Coast Guard is fully committed to supporting OCONUS requirements within the context of the current Joint Strategic Capabilities Plan and stands ready to support emerging riverine requirements subject to service capability and capacity. The level and type of Coast Guard support provided for riverine operations will require further study and assessment.

- *Cyclone-class Coastal Patrol Boats (WPC)*: A 179-foot craft with an 8-foot draft. There are only four of these in service.
- *Island-class Patrol Boat (WPB)*: A 123-foot craft with a 6-foot draft. There are eight in service, and they may replace the 110-foot WPB.
- *Island-class Patrol Boat (WPB)*: A 110-foot craft with a 5.5-foot draft. There are 41 of these in service; six are currently in the North Arabian Gulf conducting maritime security operations around Iraqi oil platforms. These patrol boats are very agile and well armed, and they have the ability to support coastal and riverine operations, especially in lower river and delta areas.
- *Other boats, less than 65 feet.* The Coast Guard also possesses over 117 motor life boats (47 feet) and 172 multi-purpose utility

boats. They could be used in riverine operations for the movement of troops and cargo.

Army capabilities

Bridging craft

The Army has 23 mobile river bridge companies, each equipped with 14 BEBs. These boats have a shallow draft and are designed to stabilize an assault floating bridge—commonly referred to as "ribbon" bridge because they undulate and move under the weight of passing traffic. When a river is wider than 210 feet, bridge bays (or pontoons) can be lashed together and used to ferry troops, equipment, supplies, and vehicles. In these cases, the BEB is used as the power unit much like the Navy's powered causeway sections found in the amphibious force.

Although BEBs are used primarily for bridge erection, for security and as safety boats during bridging operations, the Army has used them to conduct river patrols in Iraq. These boats are neither designed nor well equipped for riverine missions. They are not outfitted with armor or crew-served weapons. Soldiers on these boats must rely upon personal small arms for defense. Nonetheless, mobile river bridge companies are patrolling the Euphrates since the Navy and Marine Corps do not have the capacity to assist within the Army's area of operations (AO).

Other watercraft

The Army can employ some of its watercraft within the riverine environment, if necessary and conditions are right. Their craft, which resemble craft used by the U.S. Navy's amphibious forces are listed below.

- *Logistic Support Vessel (LSV)*: A 273-foot craft that displaces 4,199 light tons with a 6-foot draft (light) and 12-foot draft (heavy).

The LSV can lift about 2,000 tons of material and supplies. The Army has about 8 of these.

- *Utility Landing Craft (LCU-2000)*: A 135-foot craft with an 8-foot draft. The LCU-2000 can lift 250 tons and the Army has about 35 of these craft.[27]
- *Mechanized Landing Craft (LCM-8)*: A 74-foot craft with a 5.2-foot draft. It can lift 60 tons or 110 fully-equipped combat troops. The Army has 22.

Key takeaways

The Navy of today has inherited almost nothing in the way of specialized riverine systems or riverine-experienced personnel from its forebears. It is essentially starting from zero. On the other hand, it has a very rich resource base of doctrine and lessons learned that it can leverage.

The Navy currently fields several units skilled in the handling and support of armed, small craft operations, including harbor defense and amphibious landing craft. Some of the skills and systems involved are transferable to the riverine environment. Also, the Navy has helicopter squadrons with recent experience over Iraqi rivers. Thus, even though the Navy is developing a relatively small group of Navy personnel to flesh out the Riverine Group, that group will be able to increase its riverine capability by employing resources from other naval commands.

Likewise, the Navy has a functioning center of expertise in the design and acquisition of riverine craft: the CCD of the NAVSEASYSCOM's Carderock Division, located in Norfolk, Virginia. For decades, CCD has supported the Navy, the other armed services, the Special Operations command and other DoD and non-DoD organizations. It has been the agent for development and acquisition of the USMC SURC.

Finally, the Navy won't be the only service with a riverine capability. The Army and Marine Corps are currently performing riverine

27. Note: the Army also has two LCU-1600 craft.

missions in Iraq, and the USCG is working in the littorals off the coast of Iraq. The U.S. Navy is more supportive of and adept at joint and combined operations than it has been at any other time in its history. This makes it easier to draw on the recent and current riverine capabilities and experience of the USMC, USCG, USA, USSOCOM, and NAVSPECWARCOM, as well as those of the Royal Navy.

Defining the "maritime domain"

The United States has a vital national interest in maritime security. The country's safety and economic security depends largely upon the secure use of the world's oceans. More than 80 percent of the world's trade travels by water. Spread across Asia, North America, and Europe are 30 mega-ports/cities that constitute the world's primary, interdependent trading web. Seventy-five percent of the world's maritime trade and half its daily oil consumption pass through a handful of international straits and canals. Maritime security is required, to ensure freedom of the seas, to facilitate freedom of navigation and commerce, to advance prosperity and freedom, and to protect the resources of the ocean. All nations have a common interest in achieving two complementary objectives: to facilitate the vibrant maritime commerce that underpins their economic security, and to protect against ocean-related terrorist, hostile, criminal, and dangerous acts [24].

The National Security Presidential Directive (NSPD) 41/Homeland Security Presidential Directive (HSPD) 13 define Maritime Domain as:

> All areas and things of, on, under, relating to, adjacent to, or bordering on a sea, ocean, or other navigable waterway, including all maritime-related activities, infrastructure, people, cargo, and vessels and other conveyances. [25]

Although the maritime domain seems to be focused on the oceans and the common global approaches to the United States, it also includes the geography of a nation-state, terrorism, transnational criminal activity, piracy, environmental destruction, and illegal seaborne immigration.

In this section we broaden our discussion of the maritime domain and its relationship to maritime security, identify where riverine

forces may operate within this domain, and discuss some things to consider while operating in this environment.

Strategic objectives of maritime security

The Secretaries of Defense and Homeland Security highlighted four strategic objectives in the National Strategy for Maritime Security [24]. Although these strategic objectives are focused on protecting the homeland, tasks beyond our national borders are implied by language or by current practice. The four objectives follow:

- *Prevent terrorist attacks and criminal or hostile acts* by detecting, deterring, interdicting, and defeating terrorist attacks, criminal acts, or hostile acts in the maritime domain. This is accomplished by monitoring and patrolling our maritime borders, maritime approaches, and exclusive economic zones (EEZ), as well as high seas of national interest, and by stopping such activities at any stage of development or deployment. This latter condition suggests that the United States reserves the right to preempt terrorist activities at their source. In reality, this may be difficult to do since we generally uphold another nation's sovereignty, unless it is prudent to do otherwise, and then, only when an actor or regime is undeterred. That said, the United States strives to work with foreign governments, international and regional organizations, and the private sector to solicit support for improved global maritime security and access as needed to combat terrorism at its root.

- *Protect maritime-related population centers and critical infrastructure.* Here the language is focused on population centers and critical infrastructure within the United States. Nonetheless, the United States is performing security missions in Iraq today. We are protecting the hydro-electric power and critical oil infrastructure within Iraq at the request of the provisional government of Iraq and the COCOM.

- *Minimize damage and expedite recovery from attacks within the maritime domain.* Once again, the language in [24] is focused on minimizing attacks within the United States. The United States, however, has strategic interests globally. Our forces can act as

first responders outside of the United States, and they have plans to do so should major attacks occur outside our borders.

- *Safeguard the oceans and its resources.* The language within this objective recognizes our need to assist regional partners to maintain the maritime sovereignty of their territorial seas and internal waters. By helping countries prevent unlawful and hostile exploitation of their maritime domain, we become a beneficiary and improve maritime domain awareness for all nations.

Maritime security goal and enabling tasks

The basic goal of maritime security is to create an in-depth, layered defense [25, 26]. Enabling tasks include:

- *Develop maritime domain awareness (MDA)*, which is understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of the United States, and the identification of threats as early and as distant from our shores as possible.
- *Integrate all available intelligence* in the maritime domain.
- *Coordinate maritime security initiatives* with foreign governments and international organizations.
- *Solicit international support* for enhanced maritime security.

These enabling tasks presuppose that the maritime domain is defined by a sphere of activity, interest, or functions rather than being the territory over which rule or control is exercised. This is an important distinction, which we will address later.

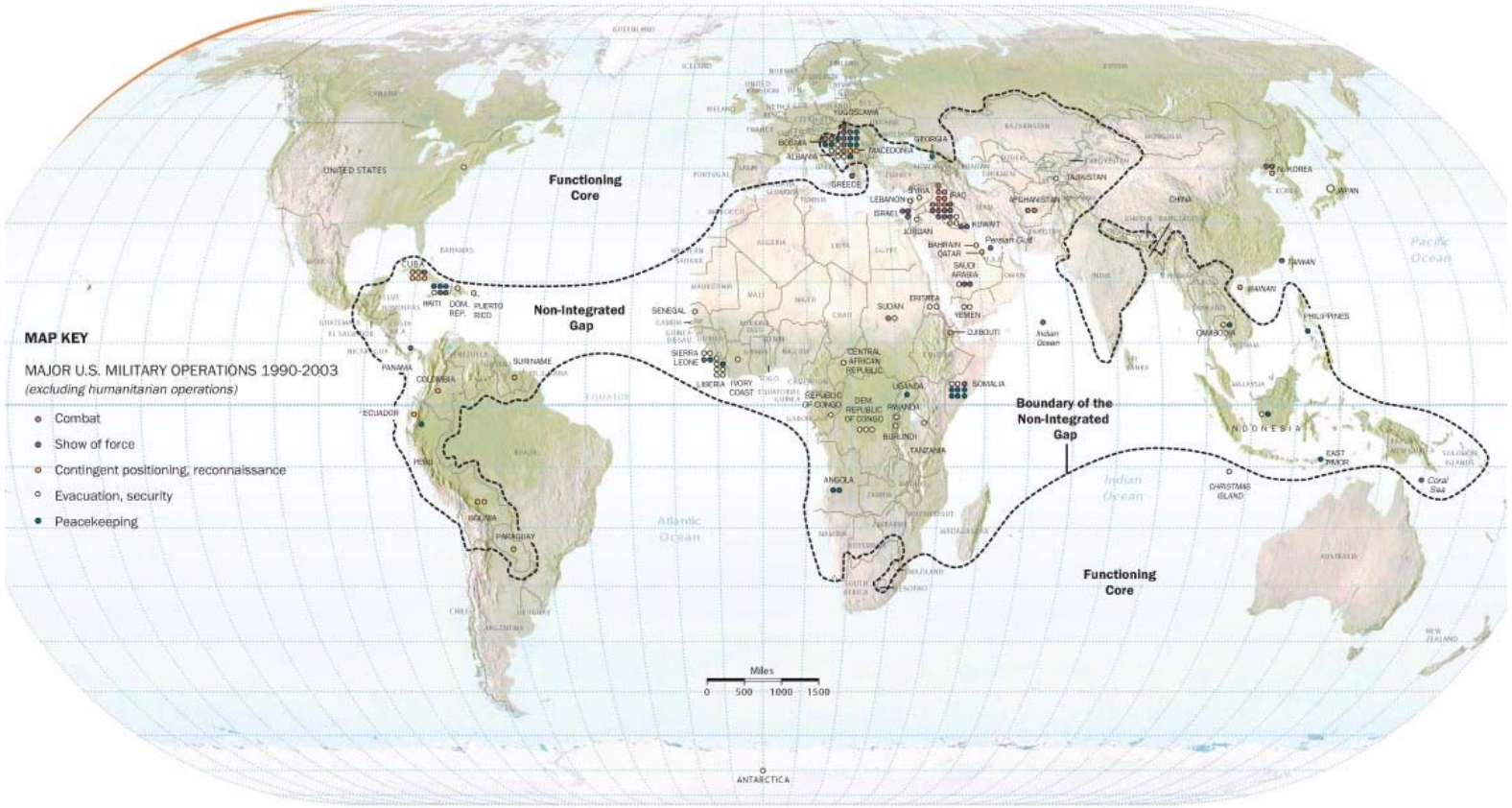
Where the "bad" guys are

We performed a map survey of all countries that have river systems within 175 miles of an accessible coastline. We excluded North America, the polar regions, and countries bordering the Caspian Sea and archipelagoes (such as Cape Verde).

Appendix D codifies each country by its potential for military operations and identifies the scope of riverine operations in that country. Potential for military operations was based on whether a country belonged to the functioning Core or non-integrating Gap. Countries that embrace "globalization" fall into the functioning Core. They accept content flow and possess normative rule sets that bind countries together in mutually assured dependence associated with integrating one's national economy to the global economy. All other countries fall into the non-integrating Gap [24]. Scope of riverine operations was determined by the ratio of waterways to paved roads in a country.

Of the 91 countries surveyed, 60 fall into the Gap. (See figure 2.) About 1.8 billion people—representing about 28 percent of the world population—live in these countries, whose median per capita income is less than $2,450 per year. The waterways within these countries encompass about 201,000 kilometers—or about 30 percent of the total length of all global waterways. Of special note, 21 river deltas lie within these countries. This is of particular interest since a delta can be quite large and difficult to control. For example, the Amazon River delta is over 270 kilometers wide at its mouth. In flood conditions, the river is 40 kilometers wide and 40 meters deep, and can be navigated inland by large ocean vessels for over 1,000 kilometers. From this perspective, the Navy's initial capability as currently envisioned is not in jeopardy of being too large for the potential areas of conflict.

Figure 2. Functioning Core and non-integrated Gap[a]



a. From [27]. Response data: U.S. Military Services via Dr. Henry Gaffney, Jr., the CNA Corporation.

Things to consider in the maritime domain

Access to operating areas is not guaranteed

Each coastal nation is (or should be) governed by admiralty law. For example, a sovereign nation has complete jurisdiction over its internal waters. Internal waters include enclosed seas, lakes, canals, rivers, as well as waters that are landward of lines connecting fringing islands along a coast, or landward of lines across the mouths of rivers that flow into the sea. The belt of water extending 12 nautical miles from the coast—referred to as territorial waters—is regarded as sovereign territory, except during innocent passage of military or civilian ships [28].

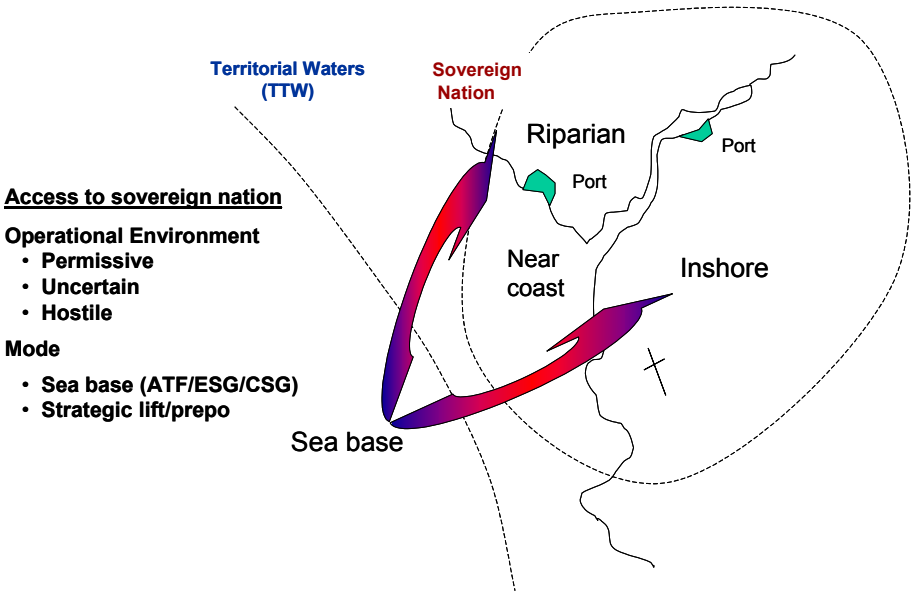
Introduction of military forces into a sovereign nation can follow any of three paths [29].

- *Permissive*. Host nation (HN) has the control, intent, and capability necessary to assist operations that a unit intends to conduct.
- *Uncertain*. HN does not have effective control of the territory and population in the intended operational area. HN may be receptive or opposed to operations that the United States intends to conduct.
- *Hostile*. Hostile forces have the control, intent, and capability necessary to effectively oppose or react to the operations that a unit intends to conduct.

Figure 3 shows a notional coastal nation. The type of operational environment (permissive, uncertain, or hostile) can affect how riverine forces are introduced into an area of operations. If the environment is permissive, forces and equipment can flow into a country via strategic lift (air or sea) as seabased forces are arriving in a theater. If the operational environment is uncertain or hostile, military forces may conduct forcible entry operations before riverine personnel, material, and supplies can safely arrive from a land or sea base. If water routes serve as a primary means of transportation and communication, riverine forces may be introduced early, especially in tropical

regions of the world (South America and Africa), where rivers and inland waterways may be the only access to a hostile force.

Figure 3. Access to a sovereign nation



In most cases, riverine forces will be phased into an area of operations after initial lodgments are established. If a riverine group or squadron operates from a seabase, the available lift assigned to Navy and Marine Corps forces may need to be reapportioned.[28]

Operating areas are complex

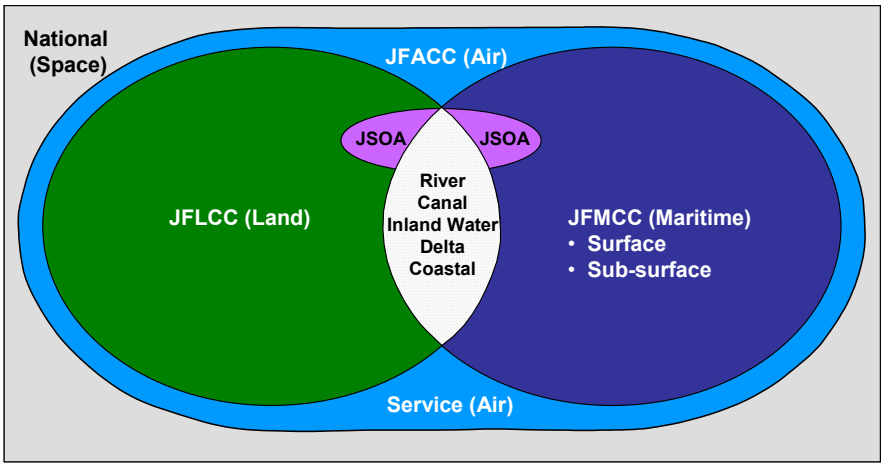
Theater operational areas are normally defined by the joint force commander for land, naval, and special operations forces. Areas of operations generally do not encompass the entire area of responsibility (AOR) of the joint force commander, but are generally large

28. It is important to note that current seabasing concepts do not consider lift requirements of a riverine force.

enough for the component commanders to accomplish their missions and protect their forces [29].

Figure 4 shows a theoretical model of overlapping component areas of operations. The maritime domain can extend over land where several components are working simultaneously.

Figure 4. Component commander areas of operations[a]



a. This graphic does not show Joint Special Operations Component Command (JSOCC). Special operations forces will attach to either the land or maritime component, or operate within a JSOA.

We show this graphic to make several points. First, maritime domain—in the physical sense (activity, interest, functions)—may fall under a Joint Force Land Component Command (JFLCC), Joint Force Maritime Component Command (JFMCC), or Joint Forces Special Operations Component Commander (JFSOCC).

Second, units from several components (Joint Force Air Component Command, service organic air, and special operations) can operate in another component's area of operations—this was a common occurrence while securing the Al Faw Peninsula during OIF. Command and control lines can become blurred, and situational awareness (SA) lost while forces are operating in close proximity to each other.

Operational planners and mission commanders need to conduct extensive planning, de-confliction, rehearsal, coordination to avoid blue-on-blue casualties.

Third, issues can surface when a river is used as boundary. During OIF I, the Navy conducted maritime interception operations (MIO) and countermine operations on the Khowr Adb Allah (KAA) while the JFLCC owned the battlespace on either side of the river. Marines were located on one side and Army units on the other. Activities had to be de-conflicted between JFLCC and JFMCC, and the ground forces on each side of the river.

Multi-service integration is needed

The scope of an operation will determine whether USN forces integrate with other forces. If a mission calls for the movement of a land force to an objective, for fire suppression, and for indirect fire support, the USN force may become a supporting element of the land force. If the mission calls for engaging insurgents or terrorists by using the organic capabilities resident within a Riverine Group, the USN force might work independent of a larger or adjacent forces. If other forces are located within the same battlespace, the riverine force can be the supported command.

The Navy and Marine Corps and other services have conducted extensive riverine operations in our nation's past. Riverine operations are naval in character but often involve multiple services. The Marine Corps considers the riverine environment to be within its Operational Maneuver From the Sea (OMFTS) and Ship-to-Shore Maneuver (STOM) concepts. Additionally, it sees the riverine environment as a subset of the littorals—an area ideally suited for a maneuvering MAGTF. In 1998 the Marine Corps published a concept paper on military operations in the riverine environment (MORE). This paper envisions MORE as part of a larger campaign originating from a seabase, sustained by a seabase, and, upon mission completion, returning to a seabase [18]. However, until the future maritime prepositioning force (MPF(F)) is realized, conducting operations from an expeditionary or carrier strike group (ESG or CSG) may be

problematic since neither can accommodate a riverine force without reducing combat capabilities elsewhere.

In contrast. the Army considers MORE to be a joint operation, undertaken primarily Army and Navy forces. From a historical perspective, the Army has more experience in riverine warfare than the Marine Corps. Army Field Manual (FM) 55-50 has a small chapter dedicated to riverine operations in based on the Army's experiences in Vietnam [30].[29]

Operations in a riverine environment are similar to land-based operations in many respects. Forces operate in several regimes: space, air, land, sea, and undersea—symmetrically or asymmetrically with regard to force-on-force.[30] As pointed out in [18], naval (and joint/combined) forces must control all five regimes through a combination of physical occupation, multi-spectral observation, and the ability to bring fires to bear (upon an adversary). From a campaign perspective, this makes sense. Therefore, in most circumstances combat units rarely operate independently from one another. Efforts should be synchronized with a common goal in mind.

Only through unity of command, well-defined objectives, and simplicity can forces within a riverine environment achieve unity of effort. Benefits of this approach include:

- Attainment of desired effects (strike)
- Mutual support of combat shields (shield).

For example, in security missions in OIF, the United States Marine Corps and Army are guarding improved ribbon bridges and dams along the Euphrates and Tigris rivers. Missions of this sort can involve several commands. Personnel protecting a physical structure may be performing a command and control function and point defense

29. In Vietnam, the Army relied heavily on the U.S. Navy to transport its forces. See Army Field Manual 55-50 (Army Water Transportation Operations, Chapter 7).

30. In our case, rivers and inland waterways represent "sea." Undersea is a derivative of sea.

while another force on the structure is performing seaward security. Therefore, the scene-of-action commanders (SACs) must constantly de-conflict forces to avoid blue-on-blue engagements.

The next section will discuss the riverine environment in more detail. This will lead to a discussion of operations and tasks in that environment in the following section.

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Analytical methodology for determining riverine requirements

In this section we will examine riverine tasks, conditions, standards, and resources. This analytical structure will provide the terms and concepts for a discussion and assessment of projected capabilities in subsequent sections.

By "capability" we mean the ability to execute a specified course of action. A course of action is composed of supporting tasks, performed under given environmental conditions, according to the commander's desired standard for mission success. Performing a desired set of tasks under given conditions and standards implies that the necessary resources are in place to enable that performance.

Operational and functional tasks

We reviewed several task-analysis schemes to obtain a simple scheme that accounts for historic and projected riverine tasks. Our sources included joint and service doctrinal and tactical publications, including the Universal Joint Task List (UJTL) and associated Universal Naval Task List (UNTL). Many specified and implied tasks contribute to any given operation, and an almost infinite variety of operational conditions affect them. There is no organizational scheme that presents a comprehensive set of mutually exclusive or independent tasks from which to build a self-consistent hierarchy for task analysis. From our literature review, however, we arrived at a simple task analysis scheme that is practical for the purposes of this study.

Tasks that are most likely to be addressed by riverine units can be analyzed in terms of operational tasks and functional tasks. Operations (or "operational tasks") are the highest level of task aggregation relevant to a riverine unit. We employ functional tasks (table 3) to bridge operational tasks to conditions and standards. Functional tasks

provide a more manageable number of tasks from which to derive individual and unit resource needs and requirements.

For the purposes of this study, it is not necessary to discuss tasks at the individual level. Once functional tasks, conditions, and standards are defined, service skill training and readiness standards become apparent.

Operational tasks

Table 2 presents a simple hierarchy of operational tasks that are most likely to be performed or supported by riverine units. The table is not intended to be exhaustive or prescriptive. Tasks at this level of aggregation for a military operation can be composed of hundreds to thousands of specified or implied tasks for supporting units and individuals.

Table 2. Operational tasks most relevant to riverine units

Operations Category	Operational Tasks	Significant Subtasks
Offensive operations	Riverine assault / forcible entry	Attack, insert/extract
	Raid	
	Movement to contact	
	Demonstration	
	Exploitation and pursuit	Interdiction, attack
Defensive operations	Area security, including: *River control* (along and across the waterway) *River denial* (a form of control)	Patrol (mobile); attack; interdiction[a]; visit, board, search and seizure (VBSS); waterborne guard post; control point; and counter-mobility (obstacles, mining)
	Security escort (convoys, high-value assets)	
	Mine countermeasures (MCM) and breaching	
	Retrograde	Delay, withdrawal, retirement

Table 2. Operational tasks most relevant to riverine units (continued)

Operations Category	Operational Tasks	Significant Subtasks
Operations other than war	Peace operations	Peacekeeping
		Peace enforcement
	Show of force	Forward deployment
	Security cooperation and assistance	Combined exercises,
		Riverine Training Teams; Riverine Operations Seminar Teams
		Support to foreign planning, intel, logistics, and/or effects
	Support to counter-drug operations	
	Noncombatant evacuation operation (NEO)	
	Humanitarian assistance / disaster relief (HADR)	(SAR, security, transport/distribute personnel and supplies, etc.)
Additional tasks in support of miscellaneous operations	Deploy and redeploy riverine forces	
	Search and rescue (SAR), Combat SAR (CSAR)	
	Civil support (civil defense, disaster relief)	

a. Interdiction is sometimes also referred to as interception.

Operations in the complex environment of rivers or deltas employ both land and maritime concepts, and can also include characteristics of special operations. It should not be surprising, then, to find that analysis of operational tasks in the riverine environment involves a mixture of operational concepts from all regimes of warfare.

"Attack" can be a supporting task in a variety of operations, including both offensive and defensive. Likewise, security operations can be in support of offensive operations, as in flank and rear security, as well as defensive operations (although we simply list security tasks under defensive operations).

Because LOCs are only one possible use of waterways, the more general "waterway security" includes LOC security. LOC security generally involves both area security (especially patrols) and security escort, among other supporting tasks.

Area security would also include security of installations, such as bases, or critical infrastructure, such as bridges or hydroelectric facilities.

The terms "interdiction" and "interception" are sometimes used interchangeably in various service literature but at other times used for offensive and defensive actions, respectively. If interdiction or interception is for the purpose of kinetic effects, then it is a cued attack; on the other hand, if the result will be a VBSS, then we can simply list "VBSS" under security operations even though it could also be part of an offensive operation.

Riverine forces that are quick to respond can play a pivotal role in humanitarian assistance and disaster relief. Because mountain roads and other main overland supply routes might be destroyed by an earthquake, mud slide, or flood, and because roadways can sometimes be congested with refugees, waterways might be the LOC of choice. In the case of severe flooding, watercraft would be the best means by units to rescue people and distribute humanitarian assistance assets.

Riverine forces are uniquely positioned to provide support to nations who are fighting international drug and insurgent groups. These threats are often in remote areas where roadways are more precarious for either the threat or the government forces (or both), and where traffic is driven to use waterways. In such cases riverine support or training teams can be a key asset in the combatant commander's means of building military relationships and promoting regional stability.

Functional tasks

Table 3 presents functional tasks that are most relevant to riverine operations. The functional task categories most useful to this analysis were selected to parallel the basic warfighting functions. Just as each operation will be composed of several warfighting functions, each aggregate task in support of an operation will be composed of several functional tasks. It is necessary, however, to consider both functional and operational-level tasks for overall mission readiness once the

operational environment and performance standards of the unit are better defined by the commander.

Table 3. Functional tasks for riverine units

Functional Task Categories	Example Functional Tasks
Waterborne mobility	Operate and maneuver watercraft.
	Maintain watercraft.
	Navigate waterways (day, night, weather).
	Counter waterway counter-mobility obstacles.
	Provide waterborne lift for insert/extract of personnel and gear associated with: GCE, reconnaissance and surveillance (R&S), NSW, SAR, EOD, combat and civil engineers, NEO.
Intelligence, surveillance, and reconnaissance (ISR) in vicinity of waterways	Employ visual and electronic sensors.
	Employ human exploitation team (HET) to collect local HUMINT.
	Coordinate with rotary-wing (RW) recon support for river patrol.
Target effects	Direct fire support (up to heavy machine-guns)
	Provide forward air control for fixed-wing (FW) or RW close air support (CAS).
	Act as forward observer for indirect fires.
	Conduct information ops in vicinity of (IVO) waterways.
	Employ non-lethal weapons IVO waterways.
Command, control, and communications (C3)	Conduct joint mission planning, including employment of joint intel products.
	Provide C2 organic fires and maneuver.
	Integrate direct fires and maneuver w/ adjacent GCE
	De-conflict organic direct fires w/ friendly forces and facilities IVO waterway
	Provide initial terminal guidance for helo landing zones (LZs) IVO waterways.
Logistics	Plan, coordinate, and conduct sustainment and resupply.
	Salvage equipment and watercraft.
	Manage transportation and distribution of humanitarian aid/disaster relief supplies.
	Manage casualties (medical capability).
	Evacuate casualties via waterway.
	Transfer casualties to over-land or RW transport.

Table 3. Functional tasks for riverine units (continued)

Functional Task Categories	Example Functional Tasks
Force protection or security	Protect against direct fire and rocket propelled grenades (RPGs).
	Protect against indirect fire (targeting operating base, landing sites, or river chokepoints).
	Operate in a mining / IED environment.
	Operate IVO small boats of unknown disposition.
	Protect against attack-swimmer threat.
	Recover personnel and critical equipment and watercraft under fire.
	Patrol (or coordinate with GCE to patrol) river banks IVO river operations.

Note that functional tasks under "target effects" include not only those in the traditional category "fires," but also conducting information operations, employing non-lethal weapons, and addressing non-combat objectives such as training foreign forces.

Conditions that affect task performance

Tasks assigned to a riverine force will determine the general types of resources needed. The extent of resource needs and requirements, however, will be determined by environmental factors ("conditions") that affect task performance, and the standard to which a task must be performed under those conditions to achieve mission success. In this section we will discuss some conditions of the riverine environment that are likely to affect the performance of operational and functional tasks.

The UJTL provides an extensive outline of environmental conditions that can affect task performance. Table 4 shows just the top-level

condition categories, grouped into physical, military, and civil environments.

Table 4. Condition categories

Condition categories	Sub categories
Physical Environment	Land
	Maritime
	Air (and weather, etc.)
	Space
	(Time)
Military Environment	Mission
	Forces
	C3
	Intelligence
	Deployment, movement, & maneuver
	Firepower
	Sustainment
	Threat
	Conflict
Civil Environment	Political
	Cultural
	Economic

Temporal factors (time) could be considered in a separate condition category, but they are typically modifiers within the other (spatial and conceptual) categories. For example, rain or lunar illumination (physical condition) can influence the effectiveness of an operation during certain time periods. The amount of time required during political negotiations or the time of day for commercial river traffic (civil condition) can also affect the timing of an operation. The amount of time it takes for an enemy to emplace a river mine or set up an ambush (military condition) can affect the procedures for water security operations, etc.

To account for conditions affecting the riverine environment, the UJTL lists in a group some of the physical conditions directly related to the river itself (river, canal, or delta): navigability, tidal turbulence,

current, bank gradient, etc. There are, however, other physical conditions that also affect the riverine environment. They are listed throughout the other respective sections (for example, climate and weather, foliage, urban or rural).

Civil and military conditions also obviously affect the performance of riverine tasks. They are also listed throughout the respective sections of this report.

There is an unlimited number of environmental condition variables that can affect the performance of riverine tasks. The purpose of the discussion below is not to duplicate the extensive detail in relevant planning publications, but to introduce and initiate a systematic consideration of primary factors that affect the range of desired riverine capabilities.

Conditions affecting mobility

Conditions affecting mobility can include the presence of heavy brush and rocks in the river, or counter-mobility obstacles such as wire or tethered mines. These conditions would also include the availability of organizational resources, such as combat engineer support to improve navigability or counter counter-mobility measures. Mine threats and countermeasures are discussed more fully in appendix E.

Resource requirements for various conditions affecting mobility must address operating range, speed, maneuverability, water depth, capacity (PAX seats, cargo size, weight), and hours the resource can operate between periodic maintenance requirements.

Conditions affecting ISR

Conditions affecting ISR include the type of local language, availability of non-organic sensor information, weather conditions (visibility), and terrain.

Conditions affecting target effects

Conditions affecting performance of target-effects tasks would concern availability of indirect fire support or close air support, weather and visibility, urban terrain features adjacent to a waterway, ROE and

collateral damage restrictions, and language considerations for nonlethal interactions such as information operations (IO) or training team objectives.

Conditions affecting C3

Conditions affecting C3 might address the chain of command for task-organized units, complexity of roles for coordination and information flow at each phase in an operation, transmission concerns (foliage, urban structures, solar activity), enemy interception or jamming capabilities, frequency conflicts with adjacent operations, language for combined operations with allied units, availability and location of re-transmitters or airborne re-transmitters, distance to support base, communication standard operating procedures, and joint familiarity with communication terms between coordinating units.

Conditions affecting logistics

Conditions affecting logistics might include the type of medical equipment needed for the hazards in the operational area, length of operations before resupply, proximity to basing, availability of air drops or resupply over land, availability of boats or fuel for resupply missions, enemy threats to logistical LOCs, and ability to stage supplies at intermediate sites.

Conditions affecting force protection

Conditions affecting force protection include the presence of attack swimmers and floating mines, issues such as visual and audible signature of watercraft, armor capability against direct fire and rocket-propelled grenades, and availability of combat engineering support for survivability operations (for example, base or boat dock berms).

Standards

Standards are presented in a mission-essential task list (METL) analysis, in terms of measures and criteria for minimum acceptable performance of the task for the objective of the operation.

The standard to which a task must be performed under given conditions to achieve mission success will be communicated by the commander in terms of quantitative or qualitative measures and criteria. A criterion is the minimum acceptable level of performance associated with a particular measure of task performance. Quantitative criteria are often expressed as minutes, hours, days, percentage, occurrences, or miles. (Derived from JP1-02 and UJTL.)

An example of a Navy tactical task from the UNTL would be "NTA 1.4.6—Conduct Maritime Interception." An example of a measure is: "percent of targeted forces interdicted, or percent of enemy avenues of approach closed as maneuver possibilities due to friendly barriers, obstacles, or mines."

Effects standards and their implications for resources might concern range and accuracy of weapon systems, or accuracy while moving.

For training tasks in certain cultural conditions, the commander might specify standards that require language skills and senior enlisted personnel, rather than translators and officers or middle-grade enlisted personnel, in order to achieve success in the specific mission.

The UJTL simply suggests measures; the commander must evaluate the specific mission and operational conditions to determine the most relevant measures and criteria for success.

Resource categories

In this section we will discuss categories of resources corresponding to a parallel DOTMLPF grouping that need to be in place to perform operational tasks.[31] Resource needs and requirements include doctrine and procedures; personnel and their organization, education, and training; and finally, facilities, equipment, and supplies. This outline completes the analytical structure we need to begin discussing riverine capability readiness in the next section.

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31. DOTMLPF stands for doctrine, organization, training, material, leadership and education, personnel, and facilities.

Doctrine and procedures

Doctrine and procedures are a nonmaterial resource that guide planning, training, and execution of an operation. With well-developed doctrine and TTP in place, a unit is much better to address operational objectives. In contrast, poorly developed, untested, or inappropriate doctrine or procedures can prevent a unit from satisfying otherwise advertised capabilities.

The history of Navy, Marine, and Army (including respective special forces) riverine operations is rich in content. Therefore, preparing for current and projected capabilities is a matter of updating the literature to reflect current operational concepts, threat projections, and technology improvements. Experimental exercises are also needed, to test updated doctrine and procedures.

Personnel and organization

Personnel resources involve not only having the right number of people on hand, but also having available the right occupational specialties. The way in which those people are organized for a specific operation is a nonmaterial resource that either assists or hinders a unit's ability to address operational objectives. This is primarily referring not to garrison organization, but rather to how the unit is task organized within an operation. The operational organization would include supporting and supported relationships, including attachments and adjacent units within the operation that coordinate with the riverine unit to accomplish the operational objectives.

Education and training

The education and training background of individual personnel, and the unit's training background, are nonmaterial resources that contribute to the unit's capability. These resources are perishable, so continuing education and sustainment training must be part of the advertised capability. This category also includes specific training and rehearsals within the operational task organization to identify friction and areas for improvement in all the functional tasks.

Facilities, equipment, and supplies

Included in this category are garrison resources, reach-back resources, afloat resources, and prepositioned resources. Analysis of a facility's capabilities must include the supporting infrastructure. Analysis of equipment's capabilities must include durability and required maintenance support. Analysis of supplies must include resupply requirements.

Capability sets

In the previous section, we defined a capability set as the ability to execute operational tasks (table 2) given a set of conditions (table 4) and standards set by a commander. Capability sets are supported by resources to satisfy the Joint Requirements Oversight Committee (JROC)-range of military operations.[32]

In this section, we examine how the Navy's projected stand-up of its riverine capability might support the capability sets associated with four types of military operations—security assistance, COIN, GWOT, and MCO. For the purposes of this analysis, we consider COIN and GWOT as a single category because operations in a single nation-state can be quite extensive, and it is difficult to distinguish between the two operations. The current operations in Iraq are a case in point.

The results presented below are a preliminary effort to illustrate how the Navy might use the analytical method discussed in the previous section to help it flesh out its riverine concept of operations and required operational capabilities/projected operational environments (ROC/POE). This analysis may also help the Navy determine where capability gaps exist across the JROC-range of military operations.

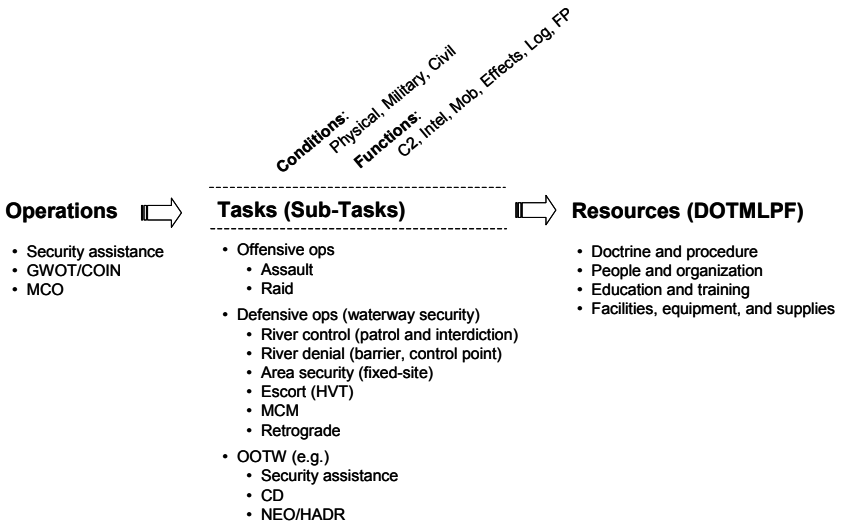
In our brief examination of capability sets, we'll focus on the functional tasks operating within each capability set, to see how projected resources fit each military operation. In order to do this, we make general assumptions regarding the physical and military conditions

32. The JROC-range of military operations include: security assistance, peace-keeping, show of force, peace enforcement, freedom of navigation, counter-insurgency, sanction enforcement, counter-proliferation, humanitarian assistance, counter-drug operations, domestic civil support, homeland defense, combatting terrorism, LOC protection, NEO, unconventional warfare, and conventional warfare [31].

of in our notional task scenarios. We can modify these as required in follow-on work.

Figure 5 diagrams this analytical approach. Normally, one works from left to right; that is, given a military operation and tasks to be performed, one determines the specific resources that are needed to satisfy the operation. We refer to this "view" as a threat-based requirement. Since the Navy has already decided to stand-up a Riverine Group, we have worked from the right to left; that is, given a set of resources and tasks to be performed, we have determined what military operations can be performed. We refer to this "view" as a capability-based requirement.

Figure 5. Analytical approach for capability set assessment



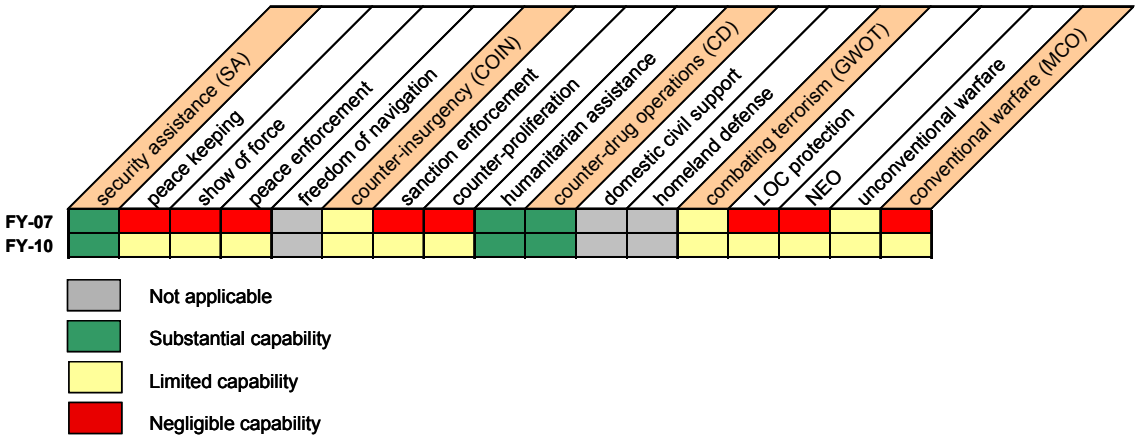
The bottom line

The Navy plans to establish a Riverine Group with three squadrons under the NECC, in order to relieve the USMC of missions in Iraq and to provide a basis of support for COIN/GWOT in FY-07 and

MCO when fully implemented in FY-09/FY-10. The initial operational capability (IOC) will comprise of one squadron (12 boats and about 200 people). The full operational capability (FOC) will comprised three squadrons (36 and 700 people).

Figure 6 presents where we think the projected resourcing of the U.S. Navy's riverine capability—mainly people and equipment—will fall on the JROC-range of military operations, based on the analysis that follows. Again, this analysis is preliminary. Findings are based on the assumptions and conditions that we used in the four illustrations which follow. These can be modified by the sponsor during follow-on work.

Figure 6. Riverine capabilities across the spectrum of military operations



In FY-07 the Navy will have a substantial capability to support security assistance and counter-drug operations. It could also support humanitarian assistance/disaster relief (HADR) requirements if it is properly positioned forward, or dedicated lift is available to move assets to where they are needed. Support of COIN/GWOT will be limited by size of the unit. LOC protection (river control and security) will be severely limited. Support of MCO will be negligible since the first squadron will be committed to area security in Iraq.

In FY-09/FY-10, the Riverine Group will increase its capabilities. Its size, however, will be a limiting factor, especially in support of an MCO. The extent of its support to COIN/GWOT and LOC protection will be based on area of operations, force rotation plans, and its ability to integrate with adjacent forces.

Security cooperation and assistance

Security assistance addresses U.S. strategic issues by supporting countries of interest with resources for internal stability. U.S. interests are served by strengthening allies in the GWOT, preventing insurgents from destabilizing economic or governmental institutions, and conducting operations to counter the illicit distribution of drugs.

The CNO has stated publicly that the Navy needs to be involved in security assistance [20]. With this in mind, we analyzed the Navy's potential for engaging in this type of activity.

Assumptions (conditions)

The Navy will assume the waterborne part of riverine training in South America and other countries after they field a riverine capability.

As the Marine Corps shifts its focus to LASO/COST operations within the riverine environment, the Navy will assume the waterborne element of riverine training in South America, and other countries. RTT/LASO and ROST/COST teams, comprising four-member teams (two USN and two USMC), will deploy to South America between six and 12 times a year—for about a week—to conduct riverine training and seminars.[33]

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33. In South America, Colombia generally receives RTT/ROST training about once a quarter. The other South American countries receive it less frequently. Other requirements are not known. OPNAV (N5SC) and CNA are currently developing a methodology for establishing engagement priorities for building partner-nation capacity to control maritime space. We can use this or a similar methodology to determine priority countries for riverine training if the sponsor feels this is needed in our follow-on work.

Operational tasks to be accomplished

The focus is on counter-drug operations, but can also include training foreign militaries in offensive and defensive operations highlighted in table 2.

Resources and potential capability gaps

Doctrine and procedures

Doctrine is in place to support security assistance training. TTPs, on the other hand, may need to be developed and integrated with USMC riverine training.

Personnel and organization

A manning shortfall may exist initially as the Navy engages in security assistance, because it is committed to taking over the USMC riverine mission in Iraq.

As the Navy stands up its initial capability, it needs to answer the following questions: Where will the experience for RTTs come from? Will the NECC Riverine Group source this mission? Or will the career track for riverine expertise call for post-Riverine Group assignments to RTTs? In some cultures, age and experience carry more weight than simple proficiency. If the Navy desires to field credible RTTs, it will have to address the seniority issue among all the other demands for senior-level personnel.

Education and training

SMTC and other training activities (NAVSCIATTS) are available to support the training of the trainers. A program of instruction will have to be developed to support the tasks and functions identified in tables 2 and 3.

Because foreign equipment will be used, personnel will need to become familiar on craft maintained by HN countries.

Even though the Marine Corps will very likely continue to provide foreign countries with training in basic and intermediate combat skills, the Navy will need to integrate these concepts into waterborne tasks.

Initially, these skills do not exist, but they can be acquired in the training commands.

Facilities, equipment, and supplies

Facilities are normally provided by the Department of State and country Military Groups. Boats are generally not required.

If the Navy chooses not to support security assistance operations, the USMC may have to maintain a riverine capability in its Reserve Component. This has some implications for equipment transfers between the Navy and Marine Corps.

GWOT/COIN: area security

Assumptions (conditions)

Area security will employ a layered defense and protect the site 24/7. Naval and ground forces will support the mission. A scene of action commander (SAC) will coordinate pre-planned responses to any threat within a vicinity of 5,000 meters of the area being defended under appropriate rules of engagement while the point defense is performing immediate action drills.

Sufficient boat crews and assets will be employed to minimize vulnerability and risk. The number of boats and boat crews required at each site is based on conditions at the site. For purposes of this discussion, we'll assume that four boat teams are actively engaged in the waterborne security, with two additional boat teams maintained as a QRF. Boat availability is considered to be 85 percent.

Operational and functional tasks to be accomplished

The focus of this task is defense. It includes the following sub-tasks: patrol, interdiction, VBSS, and attack. The primary objective of this task is to protect of high-value assets or infrastructure at physical site—for example, protection of dams in Iraq. Functional tasks are as follows:

Command, control, and communications

Communication with higher, adjacent, and subordinate commands is needed. Within the context of a layered defense, a SAC and boat crews must be able to communicate with the point defense. This suggests a need for a command information center (CIC) and boats configured with appropriate radios and sensors.

ISR

To adequately address and maintain SA on the river, timely information and intelligence products are needed. They can be provided by mutually supporting forces in the riverine environment or by aircraft or unmanned aerial vehicles (UAVs). A layered defense may also need the sensor capabilities of NCWG's MIUW.

Mobility

To deny, defeat, or destroy potential threats, patrol boats need to be armed and quick enough to respond to potential threats. Acceleration and agility of craft may be more important than top speed.

Effects

A layer defense requires integration of forces and fires directly involved in defense of the site. Additionally, if a physical site is attacked, a river squadron may need to call for external fire support (artillery, air, naval gun fire).

Logistics

The river squadron must have be able to transport each boat to and from a river landing site (RLS), and able to conduct basic portage.

Force protection

The Riverine Group and squadrons will need to protect its firm base, unless co-located with other units who provide this service to them.

Resources and potential capability gaps

Doctrine and procedures

Doctrine is in place to support area security operations. TTPs are also well developed. The Riverine Group can draw upon the experience and knowledge of subordinate commands within NECC. For example, the NCWG perform these missions routinely in OCONUS harbors. Additionally, Maritime Security Force detachments support a layered defense of Iraqi oil platforms and routinely communicate with afloat SACs, who perform maritime security operations (MSO) in the Northern Arabian Gulf. Finally, NECC can turn to the Navy's Tactical Training Groups that train strike groups to protect oil platforms during their pre-deployment work-ups.

Personnel and organization

The NECC organization as currently envisioned is more than adequate to support area security. Other commands within the organization perform similar force protection tasks from which experience might be drawn as NECC builds its riverine capability.

In our current scenario, about 60 percent of the initial river squadron will be employed in area security at a single facility. The squadron may be able to support only one additional area security task in an AO.

Education and training

NCWG, SMTC, and other training activities (NAVSCIATTS) are available to support requirements.

Riverine personnel need to be trained in conventional combat arms, integration of fires, and escape and evasion techniques. Training in these skills will need to obtained outside of the Navy.

Facilities, equipment, and supplies

A river squadron will comprise three four-boat detachments and about 200 personnel. The first river squadron will become operational in FY-07. Two additional squadrons will become operational over the next three years.

The Riverine Group does not have a robust combat service support ability. It must rely upon support from external agencies. River squadrons are not self-sufficient and cannot sustain themselves without external support. This could be a burden on commands that are organized to provide basic hotel, logistics, and communication support to units in their normal command structure.[34] NECC might want to consider developing a combat service support element within its structure so that it can be task organized to support logistics functions as needed.

In this notional scenario, ten boats are available to support this mission (capability set)—well within the projected resources of a single river squadron. If a physical defense required only three boats for security, three sites could be supported by a single squadron. Six are needed in the above scenario, which closely resembles the dam mission.

GWOT/COIN: river control

Assumptions (conditions)

The riverine environment is not occupied by major enemy forces. As ground forces exert greater influence in adjacent land areas, insurgents and terrorists will use the inland waterways for transportation, communication, and escape and evasion routes. Mining is not a threat.

A tactical unit normally consist of three or four boats. Boats maintain tactical separation but tend to clump together and not operate independent of one another.

Operational and functional tasks to be performed

This operational task is also primarily defensive in nature and includes the following sub-tasks: patrol, waterborne guard post, interdiction, VBSS, and attack. The primary focus of this task is

34. A theater support command might be an exception.

water-way security—for example, establishing and maintaining control of a waterway for political, economic, and military purposes.

For purposes of this analysis, river denial and MCM are not considered. Functional tasks follow:

Command, control and communications

Communication with higher, adjacent, and subordinate commands is needed.

ISR

To adequately address and maintain SA on the river, timely information and intelligence products are needed. They can be provided by mutually supporting forces in the riverine environment or by aircraft or UAVs.

Mobility

Patrol boats need to be sufficiently armed, agile, and quick enough to respond to potential threats. Insurgents and terrorists can easily set ambushes along a river or waterway. One way to counter this tactic is through mobility. With speed and agility, a craft can mitigate ambushes by quickly exiting an ambush site or kill zone. They can also avoid some enemy fires by maneuvering on the water.

In high threat environments, aircraft may be needed to extract boat crews from ambush sites along the river, or to provide CAS as boat crews clear an ambush site.

Effects

River control will require integration of fires with adjacent units. If attacked, a riverine force will need the ability to call for external fire support (artillery, air, naval gun fire).

Logistics

When operating along a river or waterway, obstacles may require multiple river landing sites and frequent portage in the middle and upper river regions. Moreover, although operations up and down a river tend to be predictable, the riverine force should try to avoid

predictable patterns of behavior when possible. Thus, the river squadron will need the ability to move boats and crews not only on the water but also off the water.

Force protections

Force protection of a river squadron's firm base or river landing site is needed.

Resources and potential capability gaps

Doctrine and procedures

Doctrine exists to operations involving river control. TTPs are identified in [19, 32 – 34].

Personnel and organization

Personnel and organization is the same as described in the previous section on area security with the noted exceptions.

Since NECC will not field two squadrons immediately, and six boats are tied up with area security as noted above, only one boat detachment can be fielded until a second riverine squadron is stood up.[35] If NECC is not burdened with area security, it can support a greater length of river or waterway—a least three major segments of river or waterway within a JFLCC's or JFMCC's AO. Length of segments will depend upon environmental conditions (called out earlier in table 4).

Education and training

Education and training is the same described for area security with the noted exceptions.

There are more requirements for training in conventional combat arms, integration of fires, and escape and evasion techniques.

35. Out of 12 boats, 10 are available. Six are supporting dam security leaving, only four boats available for river control.

Facilities, equipment, and supplies

River control is plagued by the same issues as in area security. The Riverine Group does not have a robust combat service support (CSS) capability. River squadrons are not self-sufficient and cannot sustain themselves without external support. This could be a burden on commands that are organized to provide basic hotel, logistics, and communication support to units in their normal command structure. NECC might want to consider developing a CSS element within its structure so that it can be task organized to support logistics functions as needed.

Since NECC will not field two squadrons immediately, and six boats are tied up with physical defense, only one boat detachment can be tasked with river control until a second riverine squadron is stood up.

The SURC is a capable boat. It is quick and responsive and can sometimes avoid incoming fires from a riverbank. The SURC has been equipped with some light armor and is well armed. That said, the SURC does not have stabilized gun mounts, making it is difficult to deliver effective fires.

Major combat operations (MCO)

Assumptions (conditions)

Major combat operations are extensive, and call for about the same level of effort as the Vietnam War.

Operational and functional tasks to be accomplished

Operational tasks—both offensive and defensive—were highlighted in table 2. During an MCO, river assaults and raids are likely. Additionally, MCM and other counter-mobility tasks are likely. The functional tasks are similar to those of COIN and GWOT, and were identified in table 3.

Resource and potential capability gaps

Doctrine and procedures

Doctrine exists to support operations involving MCO. TTPs are identified in [19, 32 – 34].

Personnel and organization

The initial river squadron fielded in FY-07 will only be comprised of about 200 sailors. At that time, it probably will not be able to support any MCO. Even after the other two river squadrons are fielded in FY-09/FY-10, the Riverine Group will have a limited MCO capability. In Vietnam, for example, riverine operations were supported by over 31,500 sailors in direct and indirect support of riverine operations on the Mekong Delta.

Major combat operations tend to be large. During Vietnam, the Navy and ground forces (Army and Marine Corps) conducted large-scale riverine operations along 17,700 kilometers of inland waterways and 93,700 square kilometers of the Mekong Delta, which is about the size of the state of Indiana. At its peak, over 500 boats (and ships) and 9,000 sailors were in direct support of riverine operations. Another 22,645 were in indirect support. From these data, we were able to develop the following riverine metrics found in table 5, some of which apply to other resource categories.

Table 5. Riverine metrics for comparison

Metric	Vietnam	Riverine Group[a]
Length of waterway (km) per person (direct)	1.9	25.3
Length of waterway (km) per person (indirect)	0.8	n/a
Length of waterway (km) per boat	35.4	491.7
Area of delta (sq km) per person (direct)	10.2	150.9
Area of delta (sq km) per person (indirect)	4.1	n/a
Area of delta (sq km) per boat	187.6	2,605.1

a. A Riverine Group consists of a headquarters and three squadrons—about 700 sailors and 36 boats.

Even with such large-scale operations, a quick review of table 5 suggests that U.S. forces could not have achieved riverine dominance in Vietnam. The length of waterway covered by a single boat (35 km) was too long, and the area of the delta covered by a single boat (187 sq km) was too great for coverage to be effective. If we had grouped people and boats into tactical units, the length of waterway per person and the concentration of boats within a square kilometer would have increased several fold.

Education and training

Education and training is the same as discussed in the COIN/GWOT analysis.

Facilities, equipment, and supplies

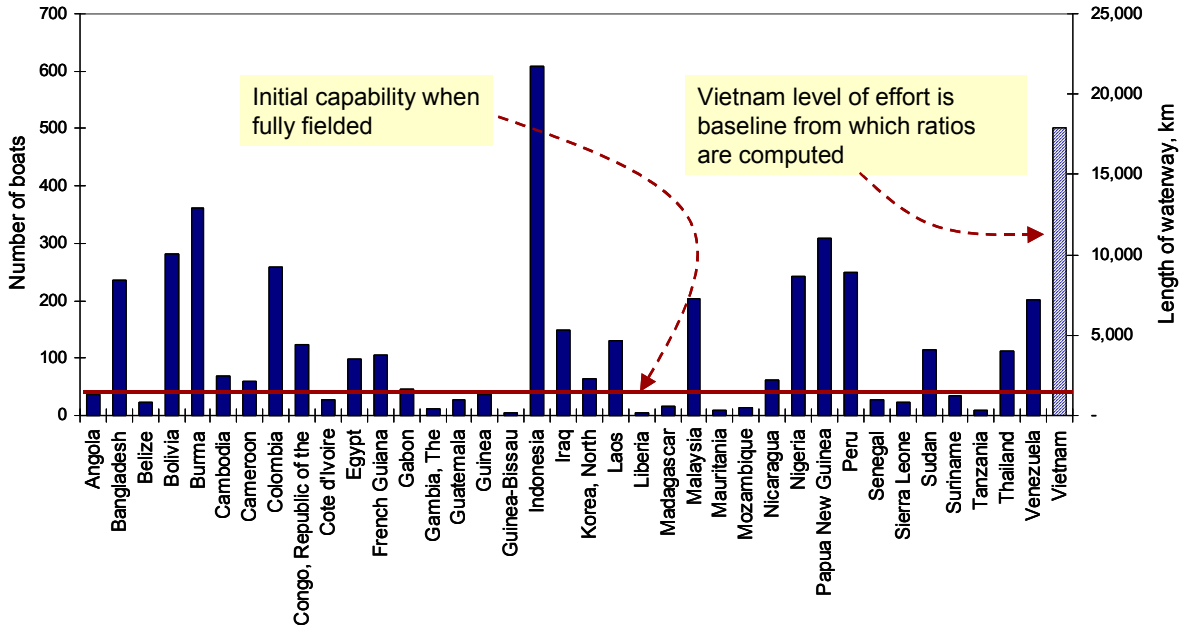
As stated earlier, the Navy's dedicated riverine force will be composed of only 36 boats. With them, the Navy could support both Army and Marine Corps battalion-sized operations. However, this isn't a lot of capability when compared to the Vietnam War level of effort.

We thought it would be interesting to map Vietnam's level of effort — our most recent MCO example of riverine operations—onto the Gap countries where the scope of riverine operations is either extensive or modest. Countries where riverine operations are limited or negligible were not considered.

Figure 7 shows the number of boats needed to support riverine tasks associated with MCO in Gap countries, based on the level of effort in Vietnam. It uses the ratios developed in table 5 to calculate how many boats might be employed in a country based on the length of its waterways, and compares the result to the number of boats the Navy will have when fully fielded (36 boats). For example, operations in Gabon

would need 36 boats to get the same level of effort as we had in the Vietnam.

Figure 7. Boats requirements (based on waterways) in Gap countries

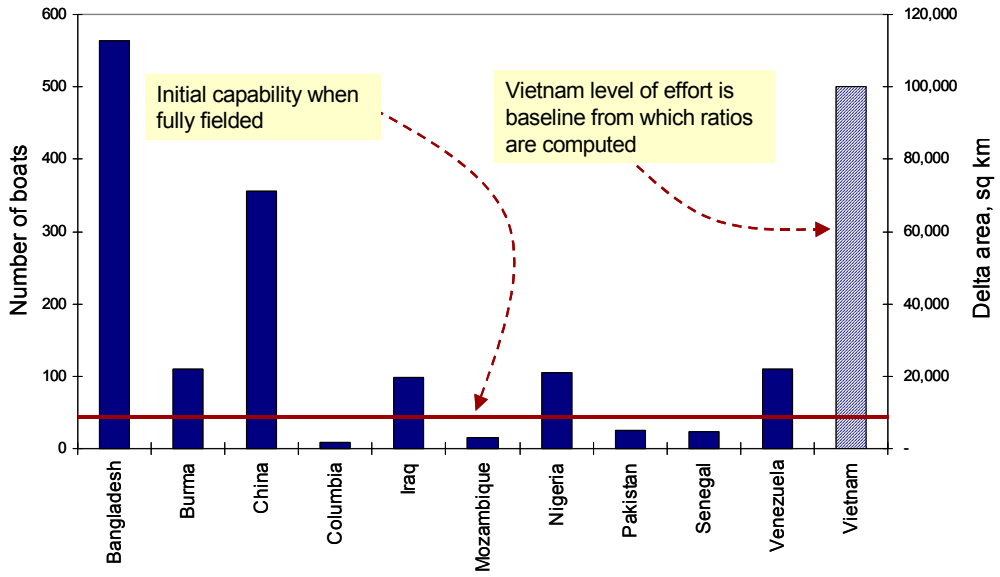


When NECC fully fields its riverine capability in FY-10, 16 Gap countries can be met with the planned capability set, based on number of boats. Twenty-two Gap countries will be outside of projected capabilities—notably Burma, Colombia, Iraq, North Korea, Nigeria, Venezuela, and Vietnam. Thus, NECC will have a capability to support an MCO, but will not have a robust capability.[36]

36. With the exception of CENTCOM, most regional combatant commands have not identified specific non-training, riverine requirements even though requirements are implied in later phases of campaigns. CENTCOM is the only combatant command with a stated requirement in a request for forces, which is to protect a fixed facility along a river.

Figure 8 uses the same methodology to view major delta systems in Gap countries. Seven counties have deltas which exceed projected initial capabilities. (We showed China on this graph even though it is not considered a Gap country.)

Figure 8. Boats requirements (based on deltas) in Gap countries



Takeaways

Key takeaways from the previous discussion are as follows.

- The Navy is not starting from scratch. Doctrine and tactics exist and are well documented. The Marine Corps is currently performing area security tasks in Iraq and has performed river control and denial operations. TTPs from their experience are making their way into the schoolhouses.
- The Navy (and Coast Guard) has a training structure in place that can quickly develop a competent, professional core of riverine professionals.

- Riverine personnel will have to develop basic infantry skills if they are going to be successful in a riverine environment. This includes the ability to call for fires (air, artillery, motors, and NGFS).
- NECC is an excellent home for the Riverine Group. Capabilities within this command can be leveraged to support riverine operations, especially in the areas of C4I, force protection and security, EOD, base construction, and logistic support if NECC decides to build a CSS capability within its structure.
- If NECC chooses to do so, it will have a substantial capability to support security assistance and counter-drug operations in FY-07. It will have limited capability to support area security and almost no capability to support river control and MCO.
- NECC will increase its capabilities through FY-10, but size of projected units will still be a limiting factor in river control and MCO.

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Way ahead

In our next task, we'll examine resource implications of force structure, training and education, equipment, and support for the capability set associated with the JROC-range of military operations. To facilitate this process, we'll need to work closely with the sponsor and NECC. We will need to ask them following questions:

- Where do you want to operate? We have suggested that the most likely areas are in the Gap countries. Since it will be impossible to analyze all of them, the sponsor or NECC may want to select those which are the most likely to call for future riverine operations.
- What environmental conditions (physical, military, and cultural) should we use as a basis for analysis?

In the final task, we'll also focus our efforts where the sponsor thinks we can best support the stand-up of the Navy's riverine capability. Areas that might be examined in our last deliverable might include:

- Modeling of security assistance requirements
- Future seabasing implications of riverine warfare.

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Appendix A: GWOT maritime missions and tasks

In this appendix, we list the six GWOT missions and 19 Navy tasks identified by the GWOT Working Group on 23 May 2005. Not all missions and task are appropriate for riverine operations. They are provided here for context.

Missions

- Deny terrorist the use of the maritime environment to develop, sustain and transfer the resources they need to operate and survive.
- Enable partner nations to counter terrorists and terrorist infrastructure in the maritime environment.
- Deny the use of maritime environment for proliferation of weapons of mass destruction (WMD), recover and eliminate uncontrolled materials in the maritime environment, and provide capacity for consequence management.
- Exploit the maritime environment in order to defeat terrorists and their organizations.
- In coordination with other government agencies and partner nations, counter state and not-state support for terrorism.
- Employ naval capabilities to counter ideological support to terrorism.

Tasks

- Conduct expeditionary support operations.
- Conduct information operation.

- Conduct ISR.
- Maintain maritime domain awareness.
- Conduct MIO.
- Conduct MSO.
- Conduct theater security cooperation (TSC) operations.
- Conduct time-sensitive precision strike.
- Enable command and control.
- Provide consequence management (CM).
- Provide FP.
- Provide CSS.
- Support civil–military operations.
- Provide law enforcement and prisoner handling.
- Conduct coalition, interagency and non-governmental organization coordination and support.
- Provide humanitarian assistance (HA).
- Share intelligence information.
- Provide support for home land security.
- Conduct counter-proliferation for WMD/E.

Appendix B: The Navy legacy

A long history

Riverine combat and other operations have been a part of U.S. Navy history from its earliest days.[37] The record is extensive as we discuss below.

Revolutionary War (1775-81)

Operations on American and Canadian rivers were conducted by a hodgepodge of local Continental Navy, Continental Army, French Navy, and state navy forces. They included unsuccessful riverine invasions of Canada; defense of the Delaware River and Philadelphia; and movement of General George Washington's army down the Chesapeake to Yorktown.[38]

Types of missions included: river assault, homeland defense, and transport operations.

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37. The most useful comprehensive reference on the U.S. Navy's riverine experience is R. Blake Dunnavent, *Muddy Waters: A History of the United States Navy in Riverine Warfare and the Emergence of a Tactical Doctrine, 1775-1989*, Ph.D. dissertation: Texas Tech University, May 1998). A less useful abridged version, which omits much of the data and analysis on doctrine and post-Vietnam developments, is *Brown Water Warfare: The U.S. Navy in Riverine Warfare and the Emergence of a Tactical Doctrine, 1775-1970* (Gainesville, FL: University Press of Florida, 2003). The most useful reference on the development of U.S. Navy riverine craft is Norman Friedman, *U.S. Small Combatants, Including PT-boats, Subchasers, and the Brown-Water Navy: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1987).

38. Books that treat Continental Navy and state navy riverine operations include Gene Williamson, *Guns on the Chesapeake: The Winning of America's Independence* (Bowie, MD: Heritage Books, Inc., 1998); and Stephen R. Taaffe, *The Philadelphia Campaign, 1777-1778* (Lawrence, KS: University Press of Kansas, 2003). See also Dunnavent, *Brown Water Warfare*, Chapter I, 1-13.

War of 1812 (1812-15)

The war included a variety of riverine operations, largely homeland defense. Examples include operations on the St. Lawrence River; Commodore Joshua Barney's defense of Chesapeake Bay and the Patuxent River; and U.S. Navy gunboat support of General Andrew Jackson before the Battle of New Orleans and at the Battle of Lake Borgne. The war saw the first U.S. Navy use of riverine daytime ambushes.[39]

Types of missions included: homeland defense.

Second Seminole War (1835-42)

The Second Seminole War was the longest and most costly Indian War, the largest fought by the United States east of the Mississippi, and the only one in which the U.S. Navy played a significant role. Riverine operations were central to this war in the Florida Everglades. The operations were conspicuously joint, involving the U.S. Army, U.S. Marine Corps, and U.S. Revenue Service (ancestor of the U.S. Coast Guard). The war saw the first U.S. Navy tactical riverine doctrine published.[40]

Types of missions included: counter-insurgency and river assault.

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39. See R. Blake Dunnavent, "Broadsides and Brown Water: The U.S. Navy and Riverine Warfare During the War of 1812," *The American Neptune* 59, no. 3 (10999), 199-210; Christine F. Hughes, "Joshua Barney: Citizen-Sailor," in Charles E. Brodine, Jr., Michael J. Crawford, and Christine F. Hughes, *Against all Odds: U.S. Sailors in the War of 1812* (Washington, DC: Naval Historical Center, Department of the Navy, 2004), 27-52; Christopher T. George, *Terror on the Chesapeake: The War of 1812 on the Bay* (Shippensburg PA: White Mane Books, 2000); and Donald G. Shomette, *Flotilla: Battle for the Patuxent* (Solomons, MD: Calvert Marine Museum Press, 1981). See also Dunnavent, *Brown Water Warfare*, Chapter II, 14-31.

40. Best reference on the Navy in the Second Seminole War is George E. Buker, *Swamp Sailors: Riverine Warfare in the Everglades, 1835-1842* (Gainesville, FL: University Presses of Florida, 1975). See also Raymond G. O'Connor, "The Navy on the Frontier," in *The American Military and the Frontier*, ed. Major James P. Tate (Washington, DC: Office of Air Force History, Headquarters USAF and USAF Academy, 1978), 37-49; and Dunnavent, *Brown Water Warfare*, Chapter III, 32-44.

Jordan River–Dead Sea Expedition (1848)

A U.S. Navy transport ship off-loaded two special oared riverine sailing craft in the eastern Mediterranean, from where they were transported to the Sea of Galilee by carriage. The pair, supported by an Arab rowboat, were used to descend the Jordan River to the Dead Sea, to conduct scientific observations and measurements, and to collect specimens.[41]

Types of missions included: riverine scientific exploring expedition.

Mexican War (1848)

During the war with Mexico, U.S. Navy sloops, smaller ships, and ships' boats made numerous combat incursions up short Mexican Gulf Coast rivers.[42]

Types of missions included: river assault.

South American river surveys (1853-5)

The U.S. Navy sidewheel-steam gunboat, USS *Water Witch,* charted the Paraguay, Parana, and Uruguay rivers. In this example of U.S. Navy riverine military operations other than war (MOOTW), she exchanged fire with a Paraguayan fort in 1856, losing a sailor during the action. She was a paddle-wheel ship rigged as a sailing schooner, and drew less than eight feet of water.[43]

Types of missions included: navigation, surveys, and naval presence.

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41. On this expedition, see CAPT Andrew C.A. Jampoler, USN (Ret.), *Sailors in the Holy Land: The 1848 American Expedition to the Dead Sea and the Search for Sodom and Gomorrah* (Annapolis, MD: Naval Institute Press, 2005); and idem. "Burning with Brimstone," *Naval History* 19 (April 2005), 53-6.

42. Mexican War riverine operations are discussed in K. Jack Bauer, *Surfboats and Horse Marines: U.S. Naval Operations in the Mexican War, 1846-48* (Annapolis, MD: Naval Institute Press, 1969). See also Dunnavent, *Brown Water Warfare,* Chapter IV, 45-58.

43. On *Water Witch*, see Donald L. Canney, *The Old Steam Navy: Vol. I: Frigates, Sloops and Gunboats, 1815-1885* (Annapolis, MD: Naval Institute Press, 1990), 41-2.

Paraguayan Expedition (1859)

This was a formidable U.S. Navy surge expedition (19 warships, plus ships' boats) up the River Plate system into Paraguay, to compel the Paraguayans to sign a commercial treaty and apologize for the *Water Witch* incident. The arrival of the fleet off Argentina was a major naval show of force. The fleet was well prepared and trained for river assault operations and riverine blockade. The Paraguayans signed the treaty, and paid an indemnity for the *Water Witch*'s dead seaman. Hostilities were therefore avoided. The Paraguayan riverine expedition was the largest U.S. military operation ever conducted on the South American continent, and the largest U.S. military operation between the Mexican War and the Civil War. [44]

Types of missions included: river incursion by seagoing warships.

Civil War (1861-65)

The Civil War saw the first large-scale U.S. Navy riverine campaigns, on the western rivers and in the east. These campaigns involved large numbers of riverine combat craft, and close joint coordination and cooperation with the U.S. Army.[45]

In the west, the Mississippi River Flotilla was the largest shallow-draft fleet ever assembled on inland waters. It included a fleet of 24 "ironclads," 76 "tinclads," and 40 other vessels, converted from civilian craft or purpose-built design. These craft were used for "traditional" riverine operations on western rivers, in conjunction with U.S. Army.

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44. See John Hoyt Williams, "The Wake of the *Water Witch*," Naval Institute *Proceedings* Supplement (1985), 14-19; and Thomas O. Flickema, "The Settlement of the Paraguayan-American Controversy of 1859: A Reappraisal," *Americas* 25 (July 1968), 49-69. For a firsthand account of riverine tactical training, see Amos Lawrence Mason, ed., *Memoir and Correspondence of Charles Steedman, Rear Admiral, United States Navy, with his Autobiography and Private Journals, 1811-1890*, Chapter XI: "The Paraguay Expedition," (Cambridge: The Riverside Press, 1912), 155-218.

45. As noted above, there is a large and useful literature on Civil War riverine operations. See especially Rowena Reed, *Combined Operations in the Civil War* (Annapolis, MD: Naval Institute Press, 1978). See also Dunnavent, *Brown Water Warfare*, Chapter V, 59-78.

The flotilla was initially under U.S. Army command and control, as the Western Gunboat Flotilla, until its transfer to the Navy command in 1862.[46]

In the south, Admiral David Glasgow Farragut and the U.S. Navy West Gulf Blockading Squadron penetrated the Mississippi River with seagoing warships, taking New Orleans.

In the east, the Union Potomac Flotilla—part of the North Atlantic Blockading Squadron—conducted riverine operations on the Potomac and other tributaries to Chesapeake Bay.[47] The Union's James River Flotilla conducted riverine transport and combat operations in support of McClellan's unsuccessful amphibious Peninsula Campaign of 1862.

For its part, the Confederate Navy launched numerous riverine homeland defense operations on western, eastern and southern rivers, using ironclads, mines, obstructions, floating batteries, and wooden gunboats (e.g., the James River Squadron).

The Civil War marked the first U.S. Navy conduct of riverine patrol operations. The extensive use of steam propulsion gave combat river craft new mobility in the face of winds and currents, but greatly increased supply, maintenance, and repair requirements.[48]

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46. On the Mississippi River campaign, see Milton M. Klein, "The Contest for the Mississippi," U.S. Naval Institute *Proceedings* History Supplement 111 (March 1985), 21-5. On U.S. Army and Navy operations on the Cumberland and Tennessee Rivers in 1862, see Spencer C. Tucker, "The Union's First Great Victories," *Naval History* 19 (December 2005), 48-55; *Andrew Foote: Civil War Admiral on Western Waters* (Annapolis, MD: Naval Institute Press, 2000); and *Unconditional Surrender: The Capture of Forts Henry and Donelson* (Abilene, TX: McWhitney Foundation Press, 2001).

47. On the Potomac Flotilla, see Eric Mills, *Chesapeake Bay in the Civil War* (Centreville, MD: Tidewater Publications, 1996).

48. On riverine tactics, especially in penetrating rivers to take cities and forts, see Donald L. Canney, *Lincoln's Navy: The Ships, Men and Organization, 1861-65* (London: Conway Maritime Press, 1998), Chapter XIII, "Civil War Naval Tactics," 186-200.

Types of missions included: multiple, joint, major riverine campaigns.

Initial Yangtze River operations (1854-1919)

The U.S. Navy deployed its first East India Squadron warship on the Yangtze River in 1854. From 1865 to the 1880s, two USN shallow-draft paddle-wheel steamers operated on the Yangtze. In 1874, USS *Ashuelot* penetrated almost 1,000 miles up the river on one deployment. At the turn of the century, two specialized gunboats were built and deployed for Chinese river service. In 1903, regular U.S. Navy, cruising on the Lower Yangtze, began using two specialized purpose-built U.S. gunboats and a few captured Spanish gunboats, home ported at Manila.[49]

Types of missions included: riverine MOOTW, presence, and engagement.

Mexican anti-piracy intervention: Teacapan River (1870)

The screw sloop USS *Mohican* anchored at the mouth of the Teacapan River and deployed six ships' boats with 60 bluejackets and Marines 40 miles up the river to attack and burn the Mexican pirate steamer *Forward*, which had been terrorizing the Mexican Pacific coast.[50]

Types of missions included: riverine penetration and assault by a seagoing warship and ships' boats.

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49. Early U.S. Navy penetrations of the Yangtze are discussed in Robert Erwin Johnson, *Far China Station: The U.S. Navy in Asian Waters, 1800-1898* (Annapolis, MD: Naval Institute Press, 1979). Specifics on the initial U.S. Navy China river gunboats and their operations are in Friedman, *U.S. Small Combatants*, Appendix B: "Gunboats," 414-20.

50. RADM Willard H. Brownson, USN, "The Pirate Ship *Forward*," in Clayton R. Barrow, Jr. ed. *America Spreads her Sails: U.S. Seapower in the 19th Century* (Annapolis, MD: Naval Institute Press, 1973), 138-52.

Korean Expedition: Han River Raid (1871)

The U.S. Navy's Asiatic Squadron conducted river assault operations on the Han River as part of a naval diplomatic effort to open Korea to foreign trade. While the squadron's frigate and corvettes anchored offshore, its two gunboats and 22 ship's boats deployed up the Han carrying 651 armed sailors and Marines. They subdued the Han River forts through naval gunfire and bluejacket-Marine amphibious assaults. But although operations were tactically sound, they failed to bring the Koreans to the conference table.[51]

Types of missions included: riverine penetration, and assault by gunboats and ships' boats.

Rio Grande Patrol (1875-79)

The Navy purchased and deployed the light draft sidewheel steamer USS *Rio Bravo* to patrol the Rio Grande River, to deter border smuggling and incursions by Mexicans into Texas. *Rio Bravo* later transferred to the Army. This riverine operation other than war (OOTW) saw the first U.S. Navy use of riverine night ambushes.[52]

Types of missions included: riverine control (border patrol).

South American river deployments (1878, 1899-1900)

In 1878 the screw sloop-of-war, USS *Enterprise,* surveyed some 1,500 miles of the Amazon and Madeira rivers, in part to help an American company build a railroad around falls in the river. In 1899-1900, a gunboat, USS *Wilmington* (PG-8), penetrated nearly 200 miles up Orinoco River in Venezuela and 2,300 miles up the Amazon River to Iquitos, Peru, to show the flag, conduct hydrographic surveys, and

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51. LtCol Merrill L. Bartlett, USMC (Ret.), and Jack Sweetman, "River Raid on Korea," *Naval History* 15 (December 2001), 43-45.

52. On the Rio Grande river patrols, see Michael G. Webster, "Intrigue on the Rio Grande: The Rio Bravo Affair, 1875," *Southwestern Historical Quarterly*, 74 (October 1970), 151-64; and Robert L. Robinson, "The U.S. Navy vs. Cattle Rustlers: The U.S.S. *Rio Bravo* on the Rio Grande, 1875-79," *Military History of Texas and the Southwest*, 15 (1979), 43-54. See also Dunnavent, *Brown Water Warfare*, Chapter VI, 79-86.

investigate American commercial opportunities. USS *Wilmington* had been built specifically for river cruising in China, and served there and in the Philippines until after World War I.[53]

Types of missions included: riverine surveying and presence (showing the flag).

Philippine War (1899-1902)

In extensive joint operations, the U.S. Army and Navy (including Marines) conducted numerous incursions up Philippine rivers, with Navy gunboats providing troop transport and gunfire support for the Army.[54]

Type of missions included: amphibious assault, gunfire support, and troop transport.

Murmansk Intervention: Dvina River campaign (1918)

As part of the U.S. Navy and U.S. Army campaigns in north Russia at the end of World War I, U.S. Navy bluejackets and Marines procured small boats and conducted operations on the Dvina, between Archangel and Kotlas, to secure the line of communication against the Bolsheviks. This operation was conducted alongside U.S. Army, Royal Navy, French Navy, and White Russian elements, and was one of the few times in history that U.S. Navy units have actively engaged Russian or Soviet forces.[55]

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53. On the South American river cruises, see Captain Paul M. Simoes de Carvalho, USAR, "Gunboat Diplomacy on the Orinoco," *Naval History* 17 (August 2003), 42-47.

54. On the U.S. Navy in the Philippine War and its cooperation with the U.S. Army, see Brian McAllister Linn, *The Philippine War 1899–1902*, (Lawrence: University Press of Kansas. 2000); and Commander Frederick L. Sawyer USN (Ret.), *Sons of Gunboats* (Annapolis, MD: United States Naval Institute, 1946.

55. On the Dvina River campaign, see Leo J. Daughterty III, "'Bluejackets and Bolsheviks'—The U.S. Navy's Landings at Murmansk: April 1918-December 1919," *Journal of Slavic Military Studies*, 18 (March 2005), 109-52. See also RADM Kemp Tolley, USN (Ret.), "Our Russian War of 1918-19," U.S. Naval Institute *Proceedings* 95 (February 1969), 61-2.

Types of missions included: river assault, control (lines of communication).

Yangtze Patrol (1919-1941)

In 1919 a formal Yangtze River Patrol squadron was designated, organized, and homeported from 1921 at Shanghai. In 1927-28 a new generation of modern, purpose-built, China-built, U.S. Navy river gunboats was deployed, including the ill-fated USS *Panay*, bombed by the Japanese in 1937. "YangPat" patrolled the middle and upper reaches of the Yangtze River, conducting various MOOTW, such as protecting U.S. commercial and missionary interests, negotiating with local warlords, showing the flag vis-à-vis other foreign powers in China, convoying American merchant cargoes, and occasionally fighting armed actions against river pirates, bandits, and warlord soldiers. The patrol was disbanded and withdrawn to the Philippines in December 1941.[56]

Types of missions included: classic riverine OOTW.

World War II: Rhine River crossing (1945)

During the last two months of the European war, the U.S. Navy supported Army operations crossing the wide, fast-flowing Rhine River with three boat units of 1,000 men, manning 72 LCVPs, 45 LCMs, and SeaBee pontoon units. Army craft could not handle the 8-knot current. The U.S. Navy craft were transported to Europe in Royal Navy LSDs, and then on trailers across France to the Rhine.[57]

Types of missions included: major river crossing.

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56. On the Yangtze Patrol and its gunboats, see Kemp Tolley, *Yangtze Patrol: The U.S. Navy in China* (Annapolis, MD: Naval Institute Press, 1971); and Friedman, *U.S. Small Combatants*, 420-23. See also Dunnavent, *Brown Water Warfare*, Chapter VII, 87-109.

57. On the U.S. Army's use of the U.S. Navy to cross the Rhine, see A.B. Feuer, "One More River to Cross," *Sea Classics* 31 (July 1998), 53-56; Samuel Eliot Morison, *History of United States Naval Operations in World War II: Vol. XI: The Invasion of France and Germany, 1944-1945* (Boston: Little, Brown and Company, 1959), 317-23; and LTC Marvin C. Ellison USA, "Landing Craft in River Crossings," *The Military Engineer* 37 (November 1945), 447-9.

Occupation of Germany: Rhine and Weser River Patrols (1949-1958)

A U.S. Navy Rhine River Patrol Unit was established in 1949 to conduct peacetime patrols of a 100-mile section of the central Rhine River, between Bingen and Karlsruhe, in the U.S.-occupied zone of post-war Germany. Its initial dozen patrol boats were manned by joint Army-Navy crews. The patrol conducted exercises with other allied units, and later trained German civilians in boat handling, demolition, and river navigation. Headquartered at Wiesbaden, the Rhine River Patrol reported to the Commander, U.S. Naval Forces, Germany, under the operational control of the Commander-in-Chief, U.S. European Command (CINCEUR), and the administrative command of the Commander-in-Chief, U.S. Naval Forces Eastern Atlantic and Mediterranean (CINCNELM). As the Cold War deepened, the patrol took on a planned wartime transportation role in support of the U.S. Army. It concluded when some two dozen Rhine River Patrol landing and patrol craft were turned over to engineers of the new Federal German Army in 1958.[58]

Types of missions included: joint and combined river control and crossing support.

Korean War: Han River Demonstration (1951)

U.S. Navy commanders deployed survey teams, minesweepers, British Commonwealth frigates, and a U.S. Navy cruiser up the Han River to

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58. On the Rhine and Weser River Patrols, see Paolo E. Coletta and K. Jack Bauer (eds.), *United States Navy and Marine Corps Bases, Overseas* (Westport, CT: Greenwood Press, 1985), "Bremerhaven, Germany, U.S. Naval Advance Base, 1945- ", 50-51. On U.S. Navy riverine security cooperation with the pre-nascent Federal German Navy, see Douglas Peifer, "From Enemy to Ally: Reconciliation Made Real in the Postwar German Maritime Sphere," *War in History* 12 (April 2005), 208-223; and ibid., *The Three German Navies: Dissolution, Transition and New Beginnings, 1945-1960* (Gainesville, FL: University Press of Florida, 2002). Some COMNAVFORGER patrol craft have had unusually long and varied careers. In 1997, Germany donated to the Kazakhstan Navy four patrol boats originally built in 1952-53 for the USN Weser River Patrol. See A.D. Baker III, "Combat Fleets," U.S. Naval Institute *Proceedings* (August 1997), 93.

shell North Korean positions in the summer and fall of 1951. This demonstration was designed to support United Nations negotiating positions claiming the seaward approaches to Seoul for South Korea, during armistice talks with the North Koreans.[59]

Types of missions included: riverine naval gunfire demonstration.

French Indo-China War and Viet Cong insurgency: Advice and assistance (1950-1964)

U.S. Navy warships, including destroyers and cruisers, routinely showed the flag in the river port of Saigon during the 1950s and early 1960s. Also, while not a direct participant in combat, the U.S. Navy provided large numbers of riverine combat craft to French armed forces fighting in Indochina, and later to South Vietnamese forces fighting the Viet Cong. Most were modifications of existing World War II craft, especially landing craft. The French Navy made their own modifications in-country at the Saigon shipyard. The U.S. Navy's Bureau of Ships gained design experience from modifying existing craft to new riverine uses, and from studying the French and South Vietnamese riverine experience. When USN forces later needed their own riverine craft in Vietnam, U.S. Navy designers were ready.[60]

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59. On the Han River Demonstration, see James A. Field, Jr., *History of United States Naval Operations: Korea* (Washington, DC: Naval History Division, Navy Department, 1962), 412, 420-1; and CDR Malcolm W. Cagle USN and CDR Frank A. Manson, USN, *The Sea War in Korea* (Annapolis, MD: United States Naval Institute, 1957), 326-8.

60. On U.S. Navy port visits to Saigon and assistance to the French and South Vietnamese in riverine warfare craft, see Edwin Bickford Hooper, Dean C. Allard, and Oscar P. Fitzgerald, *The United States Navy and the Vietnam Conflict: Vol. I: The Setting of the Stage to 1959* (Washington, DC: Naval History Division, Department of the Navy, 1976); Edward J. Marolda and Oscar P. Fitzgerald, *The United States Navy and the Vietnam Conflict: Vol. II: From Military Assistance to Combat: 1959-1965* (Washington, DC: Naval Historical Center, Department of the Navy, 1986); and Friedman, *U.S. Small Combatants*, 223-8 and 283-93.

Types of missions included: river penetrations, riverine boat design, and security cooperation.

Vietnam War (1965-71)

The U.S. Navy was able to design and deploy major counter-insurgency river-assault and patrol forces within a year or two of receiving the tasking, based, in part, on a decade and a half of lessons learned from providing assistance to the French and Vietnamese navies. The river assault craft of the MRF operated with U.S. Army 9th Division in the Mekong Delta. The Army also had its own riverine boat units. A Boat Support Unit was also established to support SEALs in-country. A smaller Task Force Clearwater operated in northern South Vietnam, 1968-1970, on the Cua Viet and Perfume Rivers. Riverine craft were based afloat and ashore, and were supported by U.S. Navy attack helicopters and fixed-wing aircraft.[61]

Types of missions included: large-scale, joint, combined riverine operations (campaigns), river assault, control (patrol), minesweeping, and special operations support.

Congo Advisory effort (1970)

Chief of Naval Operations Admiral Elmo R. Zumwalt, Jr., sent an experienced U.S. Navy Vietnam veteran captain to the Congo to assess potential Congolese river patrol programs. A small training program for Congolese personnel was set up.[62]

Types of missions included: riverine security cooperation.

Naval Small-Craft Instruction and Technical Training School (NAVSCIATTS) (1969-99)

In 1969 the U.S. Navy took over responsibility from USCG of a school in Panama to train Latin American navies in riverine operations and

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61. References on U.S. Navy operations in Vietnam are provided in the main text of this paper.

62. ADM Elmo R. Zumwalt, Jr., U.S. Navy (Ret.), *On Watch: A Memoir* (New York: Quadrangle Books, 1976) (308-10).

logistics. The school relocated from Panama, along with all other U.S. forces that had been stationed there. In 1999, it moved to Stennis (Bay St. Louis), Mississippi. At the same time, funding responsibility shifted to NAVSPECWARCOM (and USSOCOM).[63]

Types of missions included: riverine security cooperation.

Post-Vietnam era continental United States (CONUS) riverine capability maintenance (1971-1980s)

After the Vietnam war, riverine warfare became one of many missions of the ever-dwindling, mostly reserve-manned coastal river squadrons (COSRIVRONs). These units eventually migrated to NAVSPECWARCOM, and their residual riverine components focused exclusively on SEAL operation support, including security cooperation training in Latin America.[64] Meanwhile, the U.S. Marines developed a modest interest and capability in riverine operations, but failed to persuade the Navy to do the same. Much of the funding for the Special Operations and Marine Corps programs came from outside the Department of Defense.[65]

Types of missions included: dwindling riverine assault and patrol capability.

63. The basic reference on NAVSCIATTS and other U.S. Navy and U.S. Marine Corps Latin American riverine training programs is Margaret Daly Hayes, Patrick Roth et al., *Future Naval Cooperation with Latin America: Program Descriptions and Assessment*, CNA Research Memorandum 94-64, December 1995, 121-2.

64. For a prescient argument made during that period that riverine warfare should become a USMC responsibility, see LTJG Christopher A. Abel, USN, "Forgotten Lessons of Riverine Warfare," U.S. Naval Institute *Proceedings*, 108 (January 1982), 64-8.

65. On the U.S. Navy's riverine capabilities after the Vietnam War, see Scheffer, *The Rise and Fall of the Brown Water Navy;* Dunnavent, *Muddy Waters,* Chapter X: "Conclusion."

NAVSPECWARCOM Latin American riverine assistance operations (1990s)

Throughout the 1990s, the U.S. Special Operations Command deployed SEAL and supporting Boat Support Unit personnel to Latin America to conduct riverine training for selected navies.[66]

Types of missions included security assistance.

Operation Iraqi Freedom (OIF) (2003-).

Type of missions included: river and port security, minesweeping and special operations support.[67]

Summary

Despite this long and clear record, the Navy has not normally regarded its riverine operations as central to its tradition, identity, or ethos.[68] With the arguable exceptions of the Civil War and the Vietnam War, the Navy's operational history on the world's rivers is virtually unknown throughout the service, and receives scant attention in most scholarly and popular histories of the Navy. Even the Civil War and Vietnam riverine experiences are often overshadowed by more renowned naval operations occurring during those wars.[69]

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66. On Naval Special Warfare riverine operations in Latin America, see Willey, "The Art of Riverine Warfare."

67. There is little mention in the open literature of U.S. Navy riverine operations in Iraq. See, however, Michael Newsom, "Special Delivery: Navy Riverboat Team Assists U.S. Missions in Middle East," *Sun-Herald* (Mississippi, July 28, 2005).

68. Riverine assignments in the 1990s were often not considered "career enhancing" by U.S. Navy officers, despite the career success of many riverine combat-experienced officers from the Vietnam Era (e.g.: Admirals William Crowe, Robert Natter, and Henry Mauz; Vice Admiral Henry Mustin). One analyst noted, "Many of those interviewed also commented how the U.S. blue-water community does not view brown-water, riverine assignments as career enhancing." See [13].

69. Examples are the battle between the ironclads USS *Monitor* and CSS *Virginia* (ex-USS *Merrimack)*, and the air war against North Vietnam.

Nevertheless, riverine operations of the past have been important parts of the Navy's history.

A varied history

No one mission set, force construct, scale. or geographical environment has characterized the U.S. Navy's record in riverine operations.

Missions and tasks

The U.S. Navy's riverine experience has encompassed the entire gamut of riverine missions and tasks. Examples include:

- *Riverine assault.* These include assaults against conventional forces (Paraguayan Expedition, Civil War, Korean Expedition) and unconventional forces (Second Seminole War, Philippine War, Dvina River Campaign, Vietnam War).
- *Control of riverine lines of communications.* These include: Civil War, Rio Grande Patrol, Yangtze Patrol, Vietnam War, and, Operation Iraqi Freedom.
- *Security operations.* These include: Vietnam War, and the Rhine and Weser River Patrols.
- *River crossings.* These include: World War II Rhine River crossing.
- *Riverine Operations Other Than War.* These include: Jordan River-Dead Sea Expedition, initial Yangtze River operations, Mexican Teacapan River operations, South American river surveys and deployments, Yangtze Patrol, and Rhine River Patrol.
- *Theater security cooperation (TSC).* These include: the Rhine River Patrol, Viet Cong Insurgency advisory effort, Vietnam War, Congo advisory effort, and NAVSCIATTS.
- *Homeland defense.* These include: the Revolutionary War, War of 1812, Civil War.

Scale

The scale of U.S. Navy riverine operations has ranged from the two sailing craft of the Jordan River-Dead Sea Expedition and the one-ship Rio Grande river patrol of 1875–79, through the 19 warships deployed to Paraguay in 1859 and the 100 or so ironclads and "tinclads" of the Civil War Mississippi River Flotilla, to the hundreds of ships, craft, and aircraft deployed in Vietnam from 1965 through 1971—with many degrees of size in between.

Geography

Riverine environments vary greatly. The U.S. Navy has operated at various times on many—but not all—of the great river systems of the world, including the Delaware, Mississippi, Ohio, and Rio Grande at home, and on the Amazon, Orinoco, Plate, Rhine, Jordan, Yangtze, and Mekong overseas. It has also operated on such minor rivers as the Han, the Teacapan, the Dvina, and the Cua Viet.

On the other hand, it has little or no experience operating on many other rivers—for example, the Danube, the Tigris and Euphrates, the Volga and the Don, the Indus, the Salween, and the Ganges.

A shared history

The Navy has seldom conducted riverine operations alone. The USCG and its predecessors, and various state and militia forces have often also been involved, both to provide capabilities lacking in the Navy and to add to Navy capabilities. Some examples are discussed below.

Army riverine operations

During the American Revolution, Continental Army generals created their own riverine units for campaigns on the Canadian border, and deployed a riverine-raiding expedition down the Ohio and Mississippi rivers to New Orleans.[70] In the Second Seminole War, with U.S. Navy advice, the Army built and deployed 100 specially designed shallow-draft "bateau" vessels, for Everglades service. In the Civil War, the original Union flotilla of riverine combat craft was formed by the U.S. Army, which later transferred command to the U.S. Navy.[71] Civil War riverine troop transport and resupply was an U.S. Army, not a U.S. Navy, responsibility.

Joint Army-Navy riverine operations in the Philippine War were the norm. Later, during World War II, the Army conducted numerous river crossing operations, often under enemy fire. In Vietnam, the 2d Brigade of the Army's 9th Division provided the afloat combat troops for the Mobile Riverine Force. The Army also deployed riverine boat units in Vietnam.

Army Engineers bridged the Sava River using riverine craft in Bosnia in 1995–96, and routinely conduct combat riverine patrols and ambushes in Iraq, using BEBs during Operation Iraqi Freedom. Lessons learned from the Sava River operation and foreseen requirements for possible combat bridging operations in Iraq triggered an early 21st century revival of Army Engineer bridge crossing capabili-

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70. The Army's role in riverine operations is discussed in Benjamin King, Richard Biggs, and Eric R. Criner, *Spearhead of Logistics: A History of the United States Army Transportation Corps* (Fort Eustis, VA and Washington, DC: U.S. Army Transportation Center and Center for Military History, 2001). Early Army riverine operations are detailed in Charles Dana Gibson with E. Kay Gibson, *Marine Transportation in War: The U.S. Army Experience, 1775-1860* (Camden, ME: Ensign Press, 1992).

71. There is a large and useful literature on joint Army-Navy Civil War riverine operations. See especially Rowena Reed, *Combined Operations in the Civil War* (Annapolis, MD: Naval Institute Press, 1978); and Charles Dana Gibson, *Assault and Logistics: Union Army Coastal and River Operations, 1861-1866* (Camden, ME: Ensign Press, 1995). On Army-Navy command relations on western rivers see CDR Brent L. Gravatt, USN, "Command and Control in Joint Riverine Operations," *Military Review* (May 1984), 54-65.

ties, which bore fruit during Operation Iraqi Freedom in 2003 and subsequently.[72]

Coast Guard riverine operations

The USCG and its predecessor organizations have long had the mandate and capability to conduct riverine security operations on American domestic rivers. For years, the Coast Guard has routinely promulgated and enforced riverine navigation and safety rules, trained U.S. civilians in riverine boating, maintained riverine aids to navigation, and contained and cleaned up river oil spills. The Coast Guard has published numerous rule books and manuals laying out proper techniques and procedures regarding these activities.

The Coast Guard has also provided waterborne law enforcement training to foreign riverine forces, both at its facilities in the United States and forward in foreign riverine environments. In 1963, the Coast Guard set up a permanent Small Craft Inspection and Training Team (SCIATT) at U.S. Naval Station Rodman, in Panama. (In 1969, this facility was turned over to the U.S. Navy to run, as NAVSCIATTS.[73])

The Coast Guard experience in Vietnam was extensive, but chiefly coastal. Eighty-two-foot Coast Guard patrol boats (WPBs) were sent into rivers and canals in 1968 as part of Operation SEALORDS (Southeast Asia Lake, Ocean, River, Delta Strategy).

During the 1980s and 1990s, Coast Guardsmen deployed to Bolivia to train the Bolivians in search and boat registration procedures. In 2003–04, the Coast Guard surveyed and reset buoys in navigable Iraqi river mouths.[74]

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72. See Dennis Steele, "Spanning the Sava," *Army* (February 1996), 16-19.

73. See discussion of capabilities for more detail.

74. On the U.S. Coast Guard in Iraq, see Basil Tripsas, Patrick Roth, and Renee Fry, *Coast Guard Operations During Operation Iraqi Freedom*, CNA Research Memorandum D0010862.A2/Final, October 2004.

An episodic history

Although the Navy's record of riverine operations has been long, it has not been continuous. The Navy has conducted numerous riverine campaigns since the American Revolution, but in general the forces have been quickly disbanded following each conflict. Maintenance of a peacetime "riverine fleet" has seldom received funding when post-war naval budgets have contracted. When a new riverine requirement has emerged, new forces usually have had to be developed from scratch.

Typically, when a threat has emerged in a riverine environment and the U.S. Navy—along with other armed forces—has been tasked to counter it. The Navy accordingly has obtained craft and equipment and deploys sailors on them for riverine operations. Formal training based on lessons learned in initial operations has ensued, and appropriate tactics have been developed and implemented. Command and control relationships have been worked out with the Army (or Marine Corps), sometimes tinged with acrimony. Once the threat has past, the U.S. Navy has typically abandoned its investment in riverine warfare, but sometimes has allowed a small cell of naval architects and engineers to continue some design work, or a small group of Reservists to maintain some aging systems. Past operational reports, lessons learned, doctrine, and tactics have been archived—and sometimes lost. A few civilian researchers, historians, and analysts have tried to make sense of the experience, in writing. Then, when a new threat has emerged, the cycle has been repeated.

Fortunately, the Navy has a good record of adapting to the riverine environment. The Navy's personnel and acquisition systems have generally been able to recruit and train riverine sailors in short order, and provide them with suitable craft and equipment. Tactics developed under fire have been quickly assimilated.

As each episode has ramped up, the Navy has often turned to its history to expand its situational awareness regarding possible appropriate current and future riverine strategies, operations, tactics, and procedures.[75]

The Vietnam episode

Relevance

The Vietnam War is the most recent major episode in the history of U.S. Navy riverine operations and the one most relevant to the Navy's current plans. This relevance derives from:

- The wide variety of riverine operations conducted and the plethora of specialized craft deployed, which illustrate today's choices
- The important role played by aviation and support assets, both afloat and ashore
- The co-existence of a U.S. Navy riverine advisory effort designed to improve an indigenous riverine capability—comparable to the international security cooperation programs envisaged today
- The example of significant joint operations and joint command and control issues
- The record of evolving U.S. Navy in-house riverine craft design capabilities
- The current availability today of Vietnam riverine-force veterans to provide advice, insight, context, and expertise.

75. For example, to provide context and background for its riverine forces fighting in Vietnam in 1969, the Navy published and widely distributed the booklet *Riverine Warfare: The U.S. Navy's Operations on Inland Waters*, Rev. ed. (Washington, DC: Naval Historical Center, Navy Department, 1969).

Overview

From 1965 to 1971 the U.S. Navy deployed several task forces with more than 500 riverine craft, helicopters, and fixed-wing aircraft, supported by both onshore and afloat bases, on the inland waterways of South Vietnam. During peak operations in 1971, over 9,000 sailors were in direct support of riverine operations while another 22,500 were in indirect support.[76]

By 1971, all U.S. Navy riverine craft and base infrastructure in South Vietnam were either turned over to the Vietnamese Navy or returned to the United States. The remaining riverine forces in the United States were grouped into coastal river squadrons, manned by active and Reserve sailors. From 1971 to 1973, the American Navy's brief but massive role on Vietnam's rivers returned to a small and strictly advisory effort. With the withdrawal of all American forces from Vietnam in 1973, even that small effort ceased.

Starting not quite from scratch

As was typical for America's riverine campaigns, there was little existing riverine capability or formalized doctrine at the start of the war. There were, however, important exceptions, including the following:

76. In-depth treatments of the stand-up of the U.S. Navy's riverine forces in Vietnam are in LCDR David J. Spangler, USN, *What Lessons Can be Drawn from U.S. Riverine Operations During the Vietnam War as the U.S. Navy Moves into the Twenty-First Century?* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1995); Edward J. Marolda, *By Sea, Air, and Land: An Illustrated History of the U.S. Navy and the War in Southeast Asia* (Washington, DC: Naval Historical Center, 1994); R.L. Schreadley, *From the Rivers to the Sea: The United States Navy in Vietnam* (Annapolis, MD: Naval Institute Press, 1992; LCDR Thomas J. Cutler, USN (Ret.), *Brown Water, Black Berets: Coastal and Riverine Warfare in Vietnam* (Annapolis MD: Naval Institute Press, 1988); Frank Uhlig, Jr. (ed.), *Vietnam: The Naval Story* (Annapolis, MD: Naval Institute Press, 1986); Victor Croizat, *The Brown Water Navy: The River and Coastal War in Indochina and Vietnam, 1948-1972* (Dorset, UK: Blandford Press, 1984); and Jean Mintz, *Game Warden, Mobile Riverine Force and Revolutionary Development Operations in the Delta*, INS Research Contribution no. 26 (Arlington, VA: Institute for Naval Studies, Center for Naval Analyses, 1969).

- A small U.S. Navy advisory element in-country already operating on the rivers and producing staff studies on counter-insurgency in a riverine environment
- Organic U.S. Navy small craft boat handling and training expertise, especially in the amphibious forces, which included the UDT and the newly constituted special warfare SEAL teams
- A mothball fleet of amphibious ships and landing craft left over from the World War II and Korean War eras
- A competent and experienced cadre of DoN naval architects, engineers, and program administrators familiar with riverine operations in Vietnam, based on previous experience assisting the French and the South Vietnamese
- A strong civilian small craft industrial base
- An inherent appreciation in the U.S. Navy of the role of naval air power and naval afloat logistic support for all naval contingencies, including riverine warfare.

Consequently, once decisions were made in 1965 to deploy riverine forces in Vietnam, actions to organize, train, and equip those forces were taken quickly, with the initial forces arriving in-country within a year.

Initial missions and tasks

The forces that the U.S. Navy deployed on the rivers of South Vietnam engaged in five general mission areas: river assault, river patrol, river minesweeping, special operations support, and fire support.

River assault

Units of various specialized, slow, 56-foot armored-craft were organized into TF 117 to support soldiers of the U.S. Army's 9th Division in the Mekong Delta region, as part of an integrated Army-Navy MRF. These craft (totalling about 200) performed transportation, command and control, fire support, medical evacuation, and other functions. Most of the craft were enhancements of existing U.S. Navy landing craft, although the assault support patrol boat (ASPB) was an original design. Some had helicopter decks. This large riverine force

had a brief life: it began operations in 1967 and was turned over to the South Vietnamese in 1969.[77]

River control (lines of communication)

In 1965, as the U.S. government began its rapid build-up of forces in Vietnam, the Navy began deploying 36-foot large personnel landing craft (LCPLs) obtained from U.S. amphibious forces as patrol boats on Vietnamese rivers and canals.[78] In 1966, these were supplemented by new, fast, 30-foot, armed (but unarmored), fiberglass patrol boats (PBRs) and were separately organized as the River Patrol Force (TF 116) to patrol the extensive river and canal system of the Mekong Delta, keeping supply routes open for South Vietnamese, U.S. and allied forces while denying the use of the waterways to the Viet Cong. This operation was known as "Game Warden." At its peak in 1968, some 200 PBRs operated in Vietnam.[79]

Between 1968 and 1970, a smaller patrol operation, Task Force Clearwater, used PBRs, minesweepers, and some river assault craft to secure riverine LOC and supply for U.S. Army and Marine forces operating in the northern part of South Vietnam.

River minesweeping

Starting in 1965, the Navy deployed modified 83-foot shallow-draft amphibious-assault minesweeping boats (MSBs), modified minesweeping LCMs (MSMs), and other minesweeping craft to Vietnam. MRF assault-support patrol boats (ASPBs) were rigged for

77. On establishing the Mobile Riverine Force, see CAPT W. C. Wells, USN, "The Riverine Force in Action, 1966-1967," in Uhlig, 412-48; and MG William B. Fulton, USA, *Vietnam Studies: Riverine Operations, 1966-1969* (Washington, DC: Department of the Army, 1973).

78. The LCPL was the most suitable craft in the then-current U.S. Navy inventory for inshore and riverine operations, but had too deep a draft for many Vietnamese riverine environments.

79. River Patrol Force operations are analyzed in Victor Daniels and Judith Erdheim, *Game Warden*, CRC 284 (Arlington, VA: Center for Naval Analyses, January 1976). On establishing the River Patrol Force, see CDR S.A. Swarztrauber, USN, "River Patrol Relearned," in Uhlig, 365-411.

mine-sweeping as well. They countered efforts by Viet Cong sappers[80] and swimmers to mine South Vietnamese waterways and the warships and merchant ships using them. This was especially vital in the Long Tau shipping channel from the sea to Saigon, through which passed much of the war material needed by the U.S. Army, U.S. Air Force, and South Vietnamese forces.[81]

Special operations support

In 1962 the Atlantic and Pacific Fleets each stood up new Naval Operations Support Groups (NOSGs) as part of their amphibious forces, and assigned to them traditional UDTs, SEAL teams, and small craft units to support them. In 1964 the Pacific Fleet NOSG stood up Boat Support Unit One, which—as part of its Vietnam mission set—came to use small, relatively stealthy riverine craft to covertly insert and extract SEALs and other special operations forces carrying out raids, ambushes, intelligence gathering, seizures, and other special operations, and to provide them with fire support.[82] These craft included the Strike Team Assault Boat (STAB) and other craft.[83]

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80. Sappers were enemy raiding parties with small arms, machine guns, shape charges, etc. Their purpose was to penetrate a defensive position and place explosives on high-value targets (HVTs).

81. In 1966, U.S. Navy riverine minesweeping forces in the Delta were organized as Mine Squadron 11 Alpha (redesignated Mine Division 112 in 1968). On U.S. Navy riverine minesweeping operations in Vietnam, see Tamara Moser Melia, *"Damn the Torpedoes": A Short History of U.S. Naval Mine Countermeasures, 1777-1991* (Washington, DC: Naval Historical Center, 1991), 92-95; Murland W. Searight, "Prepare to Sweep Mines. . .," U.S. Naval Institute *Proceedings* 96 (January 1970), 55-59; George R. Kolbenschlag, "Minesweeping on the Long Tau River," U.S. Naval Institute *Proceedings* 93 (June 1967), 90-94; and "Radio-controlled Drone Boats Used in Vietnam Minesweeping," U.S. Naval Institute *Proceedings* 96 (February 1970), 123-4.

82. In 1968, the NOSGs were re-designated as Naval Special Warfare Groups (NSWGs), still integrally attached to the Navy's fleet and type command structures.

83. On U.S. Navy Boat Support Units, see Kevin Dockery, *Navy SEALS: A Complete History from World War II to the Present* (New York: Berkeley Books, 2004), Chapter 23, "Boat Support," 554-9.

Fire support from the rivers

In areas where the rivers could accommodate them, U.S. Navy "blue-water" naval forces could and would often penetrate inland, chiefly to bring their heavier weaponry to bear on the enemy. For example, 165-foot Asheville-class patrol gunboats (PG)—drawing 10 feet of water, and mounted with 3"/50 (7.62 centimeter) guns—were so used where practicable, especially in the Cua Lon River in support of "Sea-float" (see below). River ports like Saigon could even accommodate cruisers.

Consolidation of mission and tasks (cutting Viet Cong supply network)

In 1968, the then-commander of the U.S. Naval Forces Vietnam (COMNAVFORV), Vice Admiral Elmo R. Zumwalt, Jr., instituted Operation SEALORDS.[84] Zumwalt recombined and coordinated the various task forces under his command into new mixed groups (TF 194) spread out across the delta from just north of Saigon to the Gulf of Thailand, in an effort to block Viet Cong supply movements into South Vietnam from Cambodia. Zumwalt added to the riverine force mix the PGs, 50-foot PCF ("Swift") boats, 82-foot Coast Guard WPBs, Coast Guard Boston Whaler "skimmers," and other coastal patrol craft that had heretofore been used principally in the Coastal Surveillance Force (TF 115), for "Operation Market Time" inshore coastal patrol, not riverine operations.[85]

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84. On SEALORDS, see LCDR William C. McQuilkin, USN, *Operation SEALORDS: A Front in a Frontless War: An Analysis of the Brown-Water Navy in Vietnam* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 1997); and Schreadley, *From the Rivers to the Se*a, Chapters X, XII and XVII-XX.

85. On the Navy's use of U.S. Coast Guard patrol boats, their organic small boats, and other small craft in riverine operations in Vietnam, see Alex Larzelere, *The Coast Guard at War: Vietnam, 1965-1975* (Annapolis, MD: Naval Institute Press, 1997), especially Chapter V, "Patrolling the Delta," 68-88; and LT J. F. Ebersole, USCG, "Skimmer Ops," U.S. Naval Institute *Proceedings* 100 (July 1974), 40-6.

Logistics

Logistics support for the riverine forces was a major consideration from their inception. Both afloat and ashore bases were created. Dozens of active and mothballed amphibious ships were extensively modified and sent to Vietnam to provide afloat a number of functions: command and control; messing, berthing and recreation; supply, maintenance, and repair; aviation support; and naval gunfire support. Seabees built shore facilities along the rivers as well.[86] The Mobile Riverine Force was supported by both a large afloat Mobile Riverine Base and a major riverbank shore facility at Dong Tam. Navy riverine helicopters operated from both amphibious ships—for example, LSTs—and shore bases.

Two U.S. Navy Mobile Advance Tactical Support Bases (ATSBs) were also deployed during the war:

- As part of the SEALORDS campaign, a Mobile ATSB styled "Seafloat," was created by lashing together and anchoring a series of pontoon barges in the middle of a river at the southern tip of the country, to provide a base for U.S. and Vietnamese Navy river craft and helicopters deep in a long-time Viet Cong sanctuary. It was replaced several months later by a shore base optimized for Vietnamese Navy support ("Solid Anchor").[87]
- Mobile Base II was anchored in the northern part of South Vietnam, first at the mouth of the Perfume River at Tan My, and later on the Cua Viet River.

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86. Logistics support for U.S. Navy riverine forces in Vietnam is discussed in Edwin B. Hooper, *Mobility, Support, Endurance: A Story of Naval Operational Logistics in the Vietnam War, 1965-1968* (Washington, DC: Naval History Division, 1972).

87. In the "Seafloat" concept and operation, including recommendations for its future employment beyond Vietnam, see CDR Thomas R.M. Emery, USN, "River Power," U.S. Naval Institute *Proceedings* 96 (Aug 1970), 117-21; and Schreadley, *From the Rivers to the Sea*, Chapter XIV, "Sea Float/ Solid Anchor," 215-40.

Over time, the Navy moved some of its afloat riverine logistic functions ashore due to difficulties in coping with wind, river currents, and heavy seas, and in order to prepare to leave the South Vietnamese Navy with a shore infrastructure that it could easily maintain. The afloat logistic forces also were subject to swimmer, sapper, mining, and rocket attacks.[88] Nevertheless, riverine "sea basing" was a valuable operational concept throughout the war, giving riverine logistics support forces the mobility they needed to shift location as the operating areas of the boats changed.

Training and doctrine

With many of the craft obtained from the amphibious force, the Naval Amphibious Schools at Coronado and Little Creek picked up the responsibility to train COMNAVFORV's coastal and riverine forces, as well as act advisor to the Vietnamese Navy and other U.S. Navy forces involved in counter-insurgency.[89] In 1967, the Naval Amphibious School Coronado set up a Naval Inshore Operations Training Center (NIOTC) at Mare Island, California, to train boat crews in waterways and terrain similar to those found in Vietnam.

Initially, U.S. Navy riverine forces in-country developed their own riverine doctrine, tactics, techniques, and procedures. By 1968, a Navy doctrinal publication was promulgated.[90] Over time, doctrine drawn from the Navy's Vietnam experience was published as [19].

88. For example, in 1968 Viet Cong sappers attached mines to the hull of USS *Westchester County* (LST-1167). The detonation killed 26 men. The ship, however, returned to duty off Vietnam soon thereafter.

89. One of this study's authors, CAPT Peter Swartz, USN (Ret.), was a counter-insurgency instructor and course director at Naval Amphibious School, Coronado, California, in 1967 and 1968.

90. NWP 21(A) *Doctrine for Riverine Operation*s.

Air support

The U.S. Navy has been "air-minded" since the birth of military aviation, and the in-country riverine war in Vietnam was no exception. Aviation support for surveillance, fire support, and other tasks was provided early on. Contemporary Navy anti-submarine warfare (ASW) helicopters, however, were too heavy, too large, too expensive, and too scarce for in-country riverine operations. Without suitable helicopters of its own, the U.S. Navy borrowed Army Huey helicopters and their aircrews, then later assigned its own Army-trained aircrews from HC–1. In April 1967, the Navy commissioned a dedicated riverine air support helicopter squadron: HAL–3—the "Seawolves".[91] They were based ashore and on LST "mother ships" in the Delta. Almost three dozen helicopter gunships were assigned to HAL–3 to support riverine operations by 1969.

The Navy saw the need for fixed-wing, riverine, close-air-support aircraft as well, for their faster response times, larger payloads, and lower vulnerability.[92] In 1969 a squadron of 16 OV–10 Bronco aircraft ("Black Ponies") was borrowed from the Marines, re-organized as VAL–4, painted black, and deployed in-country with Navy crews. It was based ashore in the Delta and at Vung Tau (at the entrance to the Saigon ship channel).[93]

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91. Recent discussions of helicopter support for riverine operations in Vietnam are in CAPT Richard Knott USN (Ret), *Fire From the Sky – Seawolf Gunships in the Mekong Delta* (Annapolis, MD: Naval Institute Press, 2005); and CDR David G. Tyler, USNR, "Seawolves Roll in Across the Mekong Delta," U.S. Naval Institute *Proceedings* (January 2002), 45-9.

92. On issues relating to mid-1960s fumbled attempts to provide riverine fixed-wing support, see VADM Gerald E. Miller, USN (Ret.), "McNamara Kills the Pilatus Porter," *Naval History* 19 (June 2005), 46-51; and (October 2005), 8 & 62.

93. On the naval use of OV-10s in riverine warfare, see Kit Lavell, *Flying Black Ponies: The Navy's Air Support Squadron in Vietnam* (Annapolis, MD: Naval Institute Press, 2000); and LCDR Daniel B. Sheehan, USN (Ret.), "The Black Ponies," U.S. Naval Institute *Proceedings* 114 (April 1998), 84-88.

The post-Vietnam lull

Organizational transformation

From 1971 through the turn of the century, faced with a major buildup of Soviet naval forces on the high seas around the world and with numerous crises and contingencies in the Middle East, the U.S. Navy gradually lost its riverine forces and expertise.[94]

In 1971, Naval Special Warfare Group Boat Support Units that had been supporting UDT and SEAL operations were re-designated COSRIVRONs—one in each fleet— and took over the Navy's remaining 100 or so river assault and river patrol craft as well.[95] Thus began a slow process through which the Navy's various riverine forces became reoriented solely toward special operations support missions, despite the fact that much of their equipment and written doctrine still being based on Vietnam War–era models.

In 1972, Helicopter Attack Squadron Light 3 (HAL–3) and Attack Squadron Light 4 (VAL–4) were decommissioned. The logistics support "mother ships" were also decommissioned, and they disappeared from the Navy's inventories.

The COSRIVRONs had both active and Reserve manning, and were further divided into coastal river divisions (COSRIVDIVs), based in CONUS at Mare Island, San Diego, New Orleans, Little Creek, and Great Lakes.

By 1979, with their inventories of river assault and river patrol craft falling, the COSRIVRONs were redesignated special boat squadrons (SPECBOATRONs); the COSRIVDIVs, special boat units (SBUs).

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94. On the U.S. Navy's post-Vietnam riverine experience, see LCDR Jason B. Scheffer, USN, *The Rise and Fall of the Brown Water Navy: Changes in United States Navy Riverine Warfare Capabilities from the Vietnam War to Operation Iraqi Freedom* (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 2005)

95. In 1973, the Naval Special Warfare Groups (NAVSPECWARGRUs) became Naval Inshore Warfare Commands. They reverted to the NAVSPECWARGRU designation in 1975.

Later, in 1983 the Navy's remaining UDT personnel were redesignated as SEALs, diluting Naval Special Warfare's ties to the amphibious forces. In 1985, a Naval Special Warfare Center (NAVSPECWARCEN) was created in Coronado, California, to centralize SEAL and special boat doctrine and training (including promulgating Navy riverine doctrine).[96] During the early and mid 1980s, the SEALs and SPECBOATRONs became caught up in Navy plans to implement the "Maritime Strategy," a strategic concept aimed primarily at the Soviet Union.

The late 1980s saw major changes in naval special warfare and its relationship with the rest of the Navy, with reverberations in the ever-shrinking world of naval riverine warfare. In 1987 a new joint Special Operations Command (USSOCOM) was created, with a new Naval Special Warfare Command (NAVSPECWARCOM) as its Navy component. The NAVSPECWARGRUs—and their SPECBOATRONs—were re-assigned from the fleets and their type commanders to NAVSPECWARCOM. Moreover, Congress vested USSOCOM with unique authority—for a joint unified combatant command—to budget for and acquire new systems, including small craft—outside the Department of the Navy budget and acquisition processes. Henceforth, it was USSOCOM and NAVSPECWARCOM, not "Big Navy" and the fleets, that would organize, train, and equip the SPECBOATRONs and their Special Boat Units.

Throughout the 1980s and 1990s, the SPECBOATRONs re-oriented themselves exclusively to special warfare missions. Attention shifted from overt river patrol and river assault missions were ignored in favor of the stealthy riverine insertion and extraction of SEALs and other special operations forces (SOF). During those years, such stealthy riverine operations increasingly characterized SOF's advisory and assistance role in northern South America, as the United States government found its SOF forces to be useful tools in the War on Drugs. In 1987, SBU-26 was established in Panama, focused on riverine operations.

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96. In 1993, the doctrine development function—including doctrine for riverine operations—migrated from NAVSPECWARCEN to NAVSPECWARCOM.

During the late 1990s, NAVSPECWARCOM concentrated its riverine support capabilities in one special boat unit—SBU-22. In 1997, SBU-11 in Vallejo, California—which had maintained a riverine craft capability—was disestablished, with many of its boats transferred to SBU-22. In 1988, SBU-22 moved from New Orleans to the John C. Stennis Space Center in Mississippi. By 1999, SBU-26 in Panama—which had maintained the Navy's premier riverine capability—had also been disestablished, and its assets migrated to SBU-22 in Mississippi as well.

In 2002, NAVSPECWARCOM underwent a major re-organization. As part of the re-organization, SPECBOATRON TWO became Naval Special Warfare Group Four (NSWG-4), and its subordinate special boat units—including SBU-22—became Special Boat Teams (SBTs).[97] Thus, the commanding officer of SPECBOATRON TWO reports directly to COMNAVSPECWARCOM.

Riverine operations after Vietnam

As the emphasis in riverine organization and missions turned toward special warfare, so too did the geographical and policy focus of such riverine operations: from Southeast Asia, to northern South America; and from countering Communist insurgencies and invasions, to stopping the criminal drug trade.[98] The principal U.S. Navy (and U.S. Marine Corps) riverine activity became the training of Latin American militaries in riverine planning, operations, tactics and logistics.[99]

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97. Also as part of this reorganization, responsibility for maintaining the Patrol Coastals shifted from NAVSPECWARCOM's Special Boat Units to the amphibious Navy.

98. Also, in 1970, CNO ADM Elmo R. Zumwalt, the former Navy commander in Vietnam, sent an experienced U.S. Navy captain and Vietnam veteran to the Congo to assess potential Congolese river patrol programs. He subsequently set up a small training program for Congolese personnel. See ADM Elmo R. Zumwalt, Jr., U.S. Navy (Ret), *On Watch: A Memoir* (New York: Quadrangle Books, 1976), 308-310.

99. For analyses of Naval Special Warfare's involvement in Bolivia and Peru, see LCDR Paul F. Willey USN, "The Art of Riverine Warfare from an Asymmetrical Approach," (MS thesis: Naval Postgraduate School, March 2004). See also Gonzalez, *The Colombia Riverine Program*; and LT Braddock W. Treadway USN and LtCol Mark Freitas USMC, "Stygian Myth: U.S. Riverine Operations Against the Guerrilla," (MA thesis: Naval Postgraduate School, December 1994).

SBU-26 in Panama—and later SBU-22 in Mississippi—became the Navy's principal riverine security cooperation tool.

NAVSCIATTS

In 1963, the U.S. Coast Guard set up a Small Craft Inspection and Training Team (SCIATT) at U.S. Naval Station (USNAVSTA) Rodman, in Panama, to provide training and logistics support to Latin American riverine forces. The U.S. Navy took over responsibility for SCIATT in 1969, renaming it the Naval Small Craft Instruction and Training Team (NAVSCIATT). NAVSCIATT became a naval shore activity in 1982, and a naval shore command in 1983, under COMTRALANT, restyled the Small Craft Instruction and Technical Training School (NAVSCIATTS).[100]

In 1999, NAVSCIATTS re-located from Panama to Stennis, Mississippi, alongside SBU-22. At the same time, funding responsibility for NAVSCIATTS shifted from "Big Navy" to NAVSPECWARCOM (and U.S. Special Operations Command (USSOCOM)). Today, NAVSCIATTS reports to COMNAVSPECWARCOM via the NAVSPECWARCEN. Much of its funding comes through the Naval International Program Office (Navy IPO). It is a small command, of fewer than 50 people. It uses 25-foot armed, light patrol boats (PBLs)—manufactured by Boston Whaler—for its training programs, and deploys mobile training teams (MTTs) as required to Latin America and other sites.

Since 2001, NAVSCIATTS's focus has been to transition from Latin America to the entire globe in support of the GWOT and changing USSOCOM priorities. NAVSCIATTS trainees now come from all geographic combatant commands.

100.A basic reference on NAVSCIATTS and other U.S. Navy Latin America riverine training programs is Margaret Daly Hayes, Patrick Roth et al., *Future Naval Cooperation with Latin America: Program Descriptions and Assessment*, CNA Research Memorandum 94-64, December 1995, 121-2.

Riverine craft developments

When the war ended in 1973, most of the U.S. Navy's formerly sizeable riverine force had been turned over to the South Vietnamese (and therefore were captured or sunk by the North Vietnamese). Remaining in the Navy's inventory in the United States were 12 river-assault craft (RAC), 35 PBRs, and five PCF Swifts. These were distributed to the COSRIVDIVs across the country.

In 1978, the Navy operated just three river assault craft, 20 PBRs, and five Swifts. By the end of the 1970s, all of the RAC has been disposed of, leaving only the PBRs and PCFs, which endured as late as the 1990s, although in dwindling numbers.

Meanwhile, Department of the Navy naval architects and engineers had assimilated wartime lessons learned and were designing a new generation of combat river craft—most of which would never be built. These included a replacement for the ASPB and a variety of coastal craft. Although it had little Navy riverine work to do, Naval Sea Systems Command (NAVSEA) kept its river craft design experience and expertise alive with several successes. For example:

- A descendent of the Vietnam-era riverine SEAL support craft—the Mini-ATC—was delivered to the COSRIVRONs starting in the 1970s.
- The U.S. Marine Corps RAC, deployed in the 1990s, was an updated version of the U.S. Navy Vietnam-era PBR.

Throughout the 1990s, SBU-22 and other U.S. Navy and Marine Corps riverine units employed a variety of post-Vietnam era riverine craft, including Mark II PBRs, Mini-Armored Troop Carriers (MATCs), USMC RACs, and PBLs. None proved optimal for the Latin American riverine operations of the time, and both NAVSPECWARCOM and the Marines successfully pressed the Defense Department for more modern and appropriate craft. NAVSEA naval architects and engineers were able to provide valuable support and expertise.

Consequently, a new generation of purpose-built U.S. naval riverine craft has deployed in the 21st century: the Naval Special Warfare

Command's Special Operations Craft Riverine (SOCR) and the U.S. Marine Corps' Small Unit Riverine Craft (SURC).

SBT-22 began receiving its first SOCRs in 2003, and deployed with them to Operation Iraqi Freedom. This was a historically unusual event. When naval riverine forces were required for combat, they did not have to be jerry-rigged or hastily purchased. Sophisticated riverine combat craft with trained boat crews already existed in the naval inventory, and could be deployed immediately.

"Big Navy" and riverine warfare

Naval Strategy and riverine warfare

For over three decades, after the end of the Vietnam War, the Navy wrestled with a recurrent question: "Why a Navy?" The Navy's answers to this question was promulgated in a series of documents designed to lay out the Navy's strategy, plans, and policies. These started with Admiral Zumwalt's "Project 60," promulgated when he returned from Vietnam to Washington as CNO in 1970, and continued on through "The Maritime Strategy" of the 1980s, " . . . From the Sea" and "Forward . . . From the Sea" in the 1990s, and "Sea Power 21" and the "Fleet Response Plan" in 2003 and 2004.[101]

One of the things that all of these documents —and the concepts they elucidated—had in common was that none of them discussed operations in a riverine environment. The Navy's reading of the nation's security and mil–strategic demands, and of its own capabilities and expertise, was that riverine warfare was not part of its mission set. The Navy had several competing priorities to juggle during these years, and riverine warfare was almost never able to compete with, say strike or anti-submarine warfare, for a significant share of the Navy's attention or resources.

101.For an analysis of the evolution of U.S. Navy strategic thinking during this period, see Peter M. Swartz, *U.S. Navy Capstone Strategies and Concepts: 1970-2005: Insights for the U.S. Navy of 2005*, CME D0012996.A1/SR1 (Alexandria, VA: Center for Naval Analyses, September 2005)

The Worthington Study

In August 1990, the Navy/Marine Corps Board tasked RADM George Worthington, Commander, Naval Special Warfare Command (NAVSPECWARCOM), to develop a training and operational concept to field and exercise a battalion-size riverine assault capability from existing USN force structure. In December 1990, in coordination with the U.S. Atlantic and Pacific Fleets, NAVSPECWARCOM published its findings [5]. The study advocated that the Navy and Marine Corps develop joint training and operational concepts to field a riverine assault capability from within their existing force structure. That structure comprised a MRF command element, a battalion-sized Marine air-ground task force (MAGTF), and a River Assault Group (RAG). The new MRF would comprise of waterborne, aviation, ground, combat support, and combat service support elements. In total this force would consist of about 3,000 personnel and 75 craft. The USN craft are listed in table 6.

Table 6. Navy riverine, landing and ferry craft

Craft	Lift	Mission	Draft (feet)	Qty
Landing Craft, Utility (1600), LCU	189 tons, 400 pax	C2, logistics	9	4
Landing Craft, Mechanized, LCM-8	60 tons, 200 pax	Lift, re-supply, MCM, re-fueler	5.25	12
Mini-Armored Troop Carrier, MATC	4,400#, 15 pax	Troop carrier		14
Patrol Boat, Rigid, PBR	4 crew members		Shallow	10
Patrol Boat Light, PBL	3 crew + SEAL team,	Special warfare	1.5	3
Causeway Section, Non-Powered, CNSP	Ferry material and supplies	Floating base	4	27
Side-Load Warping Tug, SLWP	Can be used to ferry material and supplies	Construction of CSNP	4	5

The Marine Corps would provide rotary- and fixed-wing aviation and 12 Amphibious Assault Vehicles (AAV).

The bill for this proposed force was more than the Navy and Marine Corps thought feasible, given the increasingly constrained post-Cold

War defense budgets and tumbling fleet force levels. The Navy's late Cold War battle force of almost 600 ships was already shedding 30 ships a year, and the Navy was hard pressed to form a riverine force with an uncertain future.

Throughout the 1990s, the Navy periodically revisited the Worthington Study. Each time, however, it ultimately backed away from re-embracing riverine operations, which it saw as a low-priority mission area in a climate of scarce defense dollars and numerous competing requirements.

Thus for more than 30 years after the Vietnam War, including more than a dozen years after the Cold War, the Navy ignored riverine operations almost totally. Instead, it was content to allow the U.S Special Operations Command (USSOCOM) and NAVSPECWARCOM to maintain (and pay for) a small, specialized, unconventional riverine capability, and to allow the Marines to acquire their own small riverine force.

The evolution of post-Vietnam Navy riverine doctrine

After the Vietnam War, despite the lack of progress in other dimensions of riverine warfare, riverine tactical doctrine continued to slowly evolve, as doctrine writers sought to codify the lessons learned from Vietnam. During the 1970s, NWP 21(A), *Doctrine for Riverine Operations* became NWP 13/FMFM 8-4, *Doctrine for Navy/Marine Corps Joint Riverine Operations*. In 1987, this became NWP 13 (Rev. A)/FMFM 7-5, *Doctrine for Navy/Marine Corps Joint Riverine Operations* – and in the 1990s it was re-numbered NWP 3-06M. Meanwhile, in 1981 the Navy published NWP 13-1, *Naval Riverine and Coastal Operations*, while the Marines published FMFM 7-5A Draft *MAGTF Riverine Operations*. In 1991 the Joint Chiefs of Staff produced Joint Pub 3-06, *Doctrine for Joint Riverine Operations*.

Through all these changes, the focus of the content of these Navy and joint formal publications continued to focus on Vietnam-style operations. Publishing them was a worthy endeavor, since the Vietnam experience needed recording; however, such operations and the forces to conduct them were in fact non-existent and had been for

some time. Therefore, the doctrine was not keeping pace with modern realities.

Operating outside the formal Joint Pub and NWP systems, the Marines and NAVSPECWARCOM attempted to update written naval riverine doctrine in 1993. In 1993, NAVSPECWARCEN published the more globally-oriented *NSW/USMC Riverine Handbook* (XL-00080-01-93). This was followed by the security cooperation-oriented *NSW/USMC Riverine Foreign Internal Defense Handbook* (XR-0080-02-93).

Finally, in August 2000, COMNAVSPECWARCOM signed out NTTP 3-06.10, the Naval Special Warfare Riverine Handbook. While this updated riverine tactical doctrine for the SEALs and Boat Support Units (BSUs)—with their emphasis on covert insertion and extraction—it also illustrated the extent to which "Big Navy" had stopped thinking about riverine operations. Meanwhile, the Chairman of the Joint Chiefs of Staff deleted Joint Pub 3-06 in September 2002. Doctrinally, riverine operations appeared to be solely the responsibility of Naval Special Warfare and a small slice of the U.S. Marine Corps.

Operation Iraqi Freedom

U.S. Navy forces participated heavily in Operation Iraqi Freedom (OIF), which commenced in March 2003. This participation involved significant "Big Navy" forces—carriers, surface combatants, amphibious ships, submarines, minesweepers, and patrol craft. It also included, however, some relatively small operations in and over the lower reaches of rivers in southeastern Iraq—mine countermeasures, helicopter surveillance, and boat patrols by Inshore Boat Units (IBUs).

The riverine operations of the U.S. Marine Corps, U.S. Army, and U.S. Special Operations Command (including NAVSPECWARCOM) were far more extensive. The Marines not only deployed their Small Craft Company on the Euphrates to guard dams and conduct counter-insurgency operations, but also employed organic MEU small craft. Army engineers used their 23-foot Mark II Bridge-Erection Boats (BEBs) to conduct riverine patrols and

ambushes on the Tigris. NAVSPECWARCOM deployed SBT-22 to help secure the river mouth ports of Umm Qasr and Basra.

The Marine and NAVSPECWARCOM riverine forces in Iraq—while tiny by Vietnam War standards—were almost unique in U.S. riverine warfare annals: They were already in existence before the war started. Thus they had a reservoir of existing capabilities on which to immediately draw trained personnel; modern specialized watercraft; command and control, support, and air power relationships; doctrine; and tactics, techniques, and procedures (TTPs). (See the Marine Corps legacy section.)

Appendix C: The Marine Corps legacy

In 1989, the Marine Corps began to exert considerable effort toward building a riverine capability on two parallel tracks. The first was the USMC Colombian Riverine Program and the second was the development of a conventional capability. These recent USMC efforts have come in a series waves within the context of a consistent acknowledgment of the importance of the riverine environment. Additionally, while the Marine Corps never fully committed to developing its riverine capability, the USMC efforts have furthered doctrinal understandings, advanced technology and contributed to current operational successes.

Early thoughts

The Marine Corps has long been aware of the potential importance of the riverine environment to its operational success. For example, in the 1940 USMC Small Wars Manual (chapter 10) discusses the tactical importance of rivers, characteristics of the riverine environment, boat characteristics, and tactical principles [35]. It states the following:

> During the estimate of the situation, or after the initiation of the intervention, it may become apparent that navigable inland waterways exist within the theater of operation to such an extent that their use by the intervening force is necessary or advisable.

Building a riverine capability

The Corps' well-established small craft assault capability (currently maintained with the MEU(SOC)s) must be distinguished from a riverine capability. The MEU(SOC)'s capability to deliver infantry companies, by small boat, in an amphibious raid is wholly different than the fully integrated mix of capabilities that may be required to

successfully accomplish a riverine mission. The one is a single ship-to-shore task while the latter is a rich mix of warfighting tasks.

As the Navy divested itself from conventional riverine forces, the Marine Corps was faced with a choice to either develop its own capability or have none. At this time the Corps had a small craft capability resident within both I Marine Expeditionary Force (MEF) and II MEF which were maintaining small squadrons for employment by the Marine Amphibious Units (MAU) they sourced. These craft were designed solely for troop transport. In 1991, realizing the need for a legitimate, comprehensive riverine capability, the Marine Corps began acquiring the RAC, and established a RAC platoon under the II MEF, Headquarters Battalion [6]. The platoon was centered on the newly purchased RAC which was a full mission capable platform with direct fire support, command and control, and long range troop transport capabilities. The RAC platoon's mission was to integrate the new RAC with the less capable rigid raiding craft (RRC) and combat rubber raiding craft (CRRC) in support of a ground element for riverine missions [36].

After the establishment of the RAC platoon, there was little meaningful support provided to the unit. The RAC platoon was therefore perpetually hampered by poor procurement practices, inadequate logistical support, non-existent career development, and ad hoc assignment practices [7]. In 1992, the Marine Corps recognized a need for improvement which was summarized in Commandant of the Marine Corps's (CMC) "USMC Riverine and Small Craft Policy". The policy stated that it was the Marine Corps goal to reinvigorate the "brown water" capability within the Department of the Navy (DoN) in order to:

- Support the ground combat element (GCE) or MAGTF
- Deploy a USN/USMC mobile riverine force—within existing naval force structure—to support the National Command Authority (NCA) in contingency operations worldwide.
- Provide support to the national security effort in the "war on drugs" [37].

Also of significance in 1992 was the formation of the Small Craft Company (SSCo). This was a consolidation the RAC platoon with the MAUs' RRC elements aboard MCB Camp Lejeune [38]. Despite this reorganization, the SCCo suffered from many of the same deficiencies as the RAC platoon. This was made clear in a Doctrine, Organization, Training & Education and Supporting Establishment (DOTES) assessment published by Marine Corps Combat Development Command (MCCDC) (in 1997) which stated that small boat operations are a "required capability for the Marine Corps" and that the current program had major deficiencies that must be addressed. The DOTES assessment clearly stated that the USMC riverine program had neither received meaningful lasting support nor made significant progress since its inception and that it was not a useful capability in its current state [39]. This understanding led to another effort to remedy the problems.

In 1997, the Riverine Center of Excellence (RCE) and the Riverine Training Center (RTC) were established in order to provide the needed structure and focus on maintaining a conventional riverine capability as well as facilitating the activities of other Marine Corps and USN commands, and various U.S. government agencies [40]. In executing the RCE concept, the RTC had a threefold mission:

- Train individuals and units in the planning and execution of conventional mobile riverine operations and amphibious raid
- Provide academic instruction, classroom and maintenance facilities, and limited logistical support to Marine riverine forces
- Provide personnel and facilities for the test and evaluation of clothing, equipment, platforms, human performance and littoral riverine doctrine.

Despite this significant surge of effort and investment, nothing substantial changed for the SCCo over the next three years as documented by an assessment in July 2000 which stated, "Due to under manning, maintenance and logistics deficiencies, the SCCo would, currently, be hard pressed to field 1/3 of its current assets at any given time" [6].

In 2001, the Marine Corps made its final effort to bring a full fledged riverine capability to fruition. This began with approval of the SURC Operational Requirements Document (ORD) which set the stage for full rate production of 40 of the new and very capable craft. Additionally, plans were made for a follow-on purchase of the SURC-Escort (SURC-E) which was to have enhanced weapon systems and C2 capabilities [40].

The following year (2002), the Courthouse Bay small boat facility was constructed at MCB Camp Lejeune, giving the SCCo a modern facility with a boat ramp for the first time. Also in that year the SCCo received serious improvement in staffing. Therefore, after 13 years of scarcity, the resources, facilities and professional character of the USMC small craft capability was nearly in place [41].

The final chapter of the SCCo history was written in 2005 when the Marine Corps decided to abandon its active duty riverine program in favor of making it a reserves function. Thus, the unit was removed from the II MEF headquarters table of organization (T/O) and it no longer exists. The SCCo assets have been redistributed to a new Dam Security Unit (DSU) which today operates under the 2nd Assault Amphibian Battalion in Iraq [41]. In conjunction with this change of policy, the SURC contract was terminated with the Corps receiving only 17 of the planned 40 boats.

Theater engagement in South America

The second track of USMC riverine development was the Marine Corps' South America engagement. The actual catalyst for renewed national interest in riverine operations and the USMC Colombian Riverine Program was the Andean Initiative, which was a component of the U.S. counter-narcotics strategy introduced by the first Bush Administration in 1989 [9]. The objective of the policy was to stem the flow of cocaine into the United States with a focus primarily on Colombia, Peru, and Bolivia [10]. Immediately after the presidential initiative was announced, the Secretary of Defense (SecDef) ordered the DoD to become actively involved in the interdiction of drug trafficking. This was to be accomplished by increasing “the effectiveness of foreign forces' efforts to destroy drug-processing laboratories;

disrupt drug-producing enterprises; and control the land, river, and air routes" [11]. The Marine Corps responded by initiating a riverine program focused on South America.

Training teams and seminars

The initial goal of the resulting CMC Latin America (LATAM) Guidance was a USMC initiated riverine program in South America—which started in earnest in Colombia—was to create a self-sufficient Colombian Marine riverine force [12]. Later it expanded to helping other South American countries grow their capabilities. In Colombia, the initial program called for the development of 15 riverine combat elements (RCEs) located in 11 different locations in Colombia [13]. Additionally, the program included U.S. assistance to the Colombian Marines (COLMAR) in boat procurement, riverine seminars, infrastructure development, riverine integrated logistics system (ILS) development, and establishing a Colombian riverine school [14]. This program, which is changing today, developed Mobile Training Teams (MTTs) and later Riverine Training Teams (RTTs) to instruct the COLMAR in riverine operations: boat handling, waterborne tactics, small unit tactics, insertion and extraction, night operations, machine-gun employment, and a real world counter drug exercise. The final piece of this USMC program has been to conduct on-site riverine seminars with Riverine Operational Seminar Teams (ROSTs) for senior Colombian officers [9] and Joint Planning Assistance Teams (JPATs) acting as liaisons to host nations. Since its inception, RTTs and ROSTs have interfaced with Argentina, Bolivia, Ecuador, Honduras, Guyana, Panama, Paraguay, Peru, and Venezuela. Of note, Peru received riverine interdiction craft and floating maintenance facilities in 1999 [15, 16] as well as construction of the Joint Peru Riverine Training Center (JPRTC) in 2000 as part of this program [42].

While some riverine training in South American is still sourced by the Marines today, the USMC reservoir of riverine expertise is drying up fast. This means that as the Navy assumes the responsibility for the riverine mission (as planned in March, 2007), it must quickly develop its expertise in order to fill the forming void. After March 2007, the South American mission will be characterized by the Marine Corps focusing on training ground combat skills in its land attack and

subsequent operations (LASO) teams and combined operations seminar teams (COST) while the Navy focuses on training waterborne operations with small craft.

Escort operations in Panama

From 1995 until the U.S. withdrawal in 1999, SCCo provided rotating detachments to Panama Canal in order to escort high-value U.S. shipping and nuclear submarines transiting the canal [17].

Doctrine and requirements development

- 1987: NWP 3-35.4, the doctrine for Navy/Marine Corps Joint Riverine Operations (reissue of FMFM 7-5) published
- 1990: Required operational capability (ROC) for a Riverine Assault Craft published by MCCDC
- 1990: Worthington Study published by USN which advocated joint USN/USMC mobile riverine force with 3000 personnel and 75 craft [5]
- 1992: CMC published "USMC Riverine and Small Craft Policy", stating USMC's goal of "reinvigorating" the Brown Water capability within DoN [37]
- 1994: USMC ROC #23 documented a need for an enhanced capability to operate in a riverine environment
- 1995: MCCDC Small Craft Program Review validated the requirement for increased support to ongoing riverine operations and training [43]
- 1996:
  - — Small Unit Riverine Craft (SURC) Operational Requirements Document (ORD) was initiated to satisfy USMC ROC #23
  - — The Family of Small Craft Mission Needs Statement (MNS) approved by Marine Requirements Oversight Council (MROC)

  - — CINCSOUTH identified a requirement for a conventional riverine capability on its Integrated Priority List [44, 45][102]

- 1997: DOTES assessment published by MCCDC
- 1998:
  - — Military Operations in the Riverine Environment (MORE) concept paper published by MCCDC [18]
  - — USMC reaffirmed Required Operational Capability #23—An Enhanced Capability to Operate in a Riverine Environment [44]
  - — CINCSOUTH identified a requirement for a conventional riverine capability in their Integrated Priority Lists [44, 45]
  - — CINCCENT listed the SCCo in Time Phased Force Deployment Data (TPFDD) for their OPLANs [44, 45]
  - — CINCUSACOM listed a "requirement for amphibious and littoral vehicles capable of water and land mobility, firepower, and survivability and lift capabilities to conduct operations in the littoral and/or riverine environments" in its Integrated Priority List [44, 45]
  - — General Officer Symposium stated that "having a riverine capability is a logical extension of our expeditionary nature and essential to OMFTS" [44]
- 2000: SURC ORD approved by MROC
- 2001: OMFTS Working Group's final report (chapter VI) stated, "the Marine Corps must be able to operate effectively in the riverine environment." [44]

102.Source: Headquarters, U.S. Marine Corps Information Paper, MAGFT/POC-40 of 24 May 2000.

The USMC Small Craft Company

Background

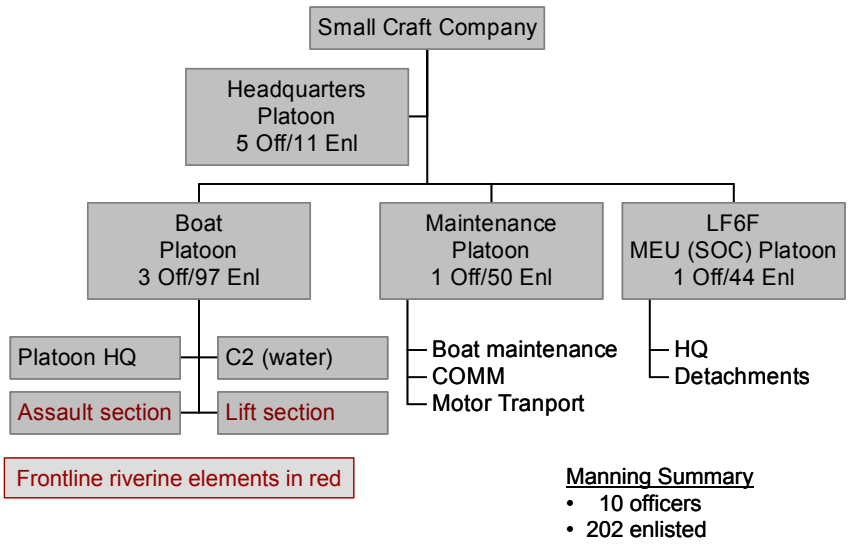
Two requirements for riverine operations are a complete employment doctrine and a robust support structure. Both of these essential elements were naturally present in the SCCo design and command structure. This is because; firstly the SCCo was staffed by infantry Marines who had a full ground combat skill-set and doctrinal base. Secondly, there was an intrinsic and broad MAGTF support structure with which the SCCo could integrate.

The following sections outline the organization, mission, tasks and employment criteria of the SSCo before and during OIF.

Organization

The SSCo was organized to provide a conventional riverine capability to MAGTFs or the other services, with up to a battalion-sized GCE [17, 46]. While the SCCo underwent several internal reorganizations, figure 9 shows how the company was organized as of their final T/O.

Figure 9. SSCo organization[a]



a. The Assault section was comprised of 16 RACs, and the Lift section was comprised of 47 RRCs. LF6F is Landing Force Sixth Fleet.

Equipment

The SSCo equipment inventory included many items that enabled them to provide some of their own combat service support (CSS). The following list of major end items is provided to provide context to the breadth of equipment required to field a Riverine Group [46, 47].

- Small craft (12 SURC, 16 RAC, 65 RRC, and 100 CRRC)[103]
- Prime movers/boat and cargo trailers (16 7-ton trucks, 13 HMMWVs)
- Fork lifts
- Generators/refrigerators/water pumps/heaters/air conditioners
- Personal and crew-served weapons
- Portable shelters/camouflage
- Fuel handling equipment
- Unit combat operations centers
- Secure communications/data suites
- Intelligence/operations workstations
- Satellite navigation and communication sets
- Nuclear biological and chemical (NBC) protective and decontamination equipment
- Troubleshooting, maintenance and repair equipment for much of the above listed equipment
- Vehicle arresting barriers/defensive barriers.

103. The SURC replaced the RAC and RRC in the SCCo. Because only 17 of 40 SURC were delivered to the USMC, a battalion-size lift using these craft was not possible in a single lift without augmentation by RRC, which are beyond its service life.

Mission

Formally stated, the SCCo mission was to provide a conventional riverine capability to include the conduct of waterborne mobility, security, command and control (C2), and combat operations in support of military operations in a riverine environment (MORE).

Tasks

The SCCo was capable of the following tasks:

- Mobility operations: conduct surface transport of personnel and equipment, insertion/extraction of GCE, logistic resupply and medical evacuation. One platoon could provide lift for a single Marine infantry company—approximately 160 Marines
- Security operations: securing of waterway LOCs, waterborne security with and without GCE embarked, reconnaissance patrols, securing waterborne movement of troops and logistics, security of riverine landing sites (RLS), escort of high-value targets (HVT), limited visit board, search, and seizure (VBSS), maritime interdiction as well as waterborne security for both ground based operations and river crossing operations[104]
- C2 operations: provide a limited C2 platform for waterborne movement and landing as well as radio relay/retransmit
- Combat operations: waterborne movement to contact, riverine ambush, combat patrols and limited direct fire support
- Supporting operations: provide the nucleus of small craft expertise to MEU battalion landing team (BLT) boat company.

Employment criteria

Before the SCCo executed an operation in Iraq the following requirements were met:

104.VBSS in this context should not be confused with the more complicated MEU(SOC) mission in support of a blue-water missions.

- Minimum of 4 small craft
- On-call close air support available with forward air controller (FAC) support
- Ground based quick reaction force (QRF) available
- Communication operator, corpsman and mechanic embarked
- Target list established with air and ground fire support elements
- De-conflicted battlespace (river plus 500 meters ashore under SCCo control)
- Extensive rehearsals before non-organic forces were embarked (This generally required 2-3 days of training).

Operations in Iraq

During OIF the SCCo performed various waterborne tasks, day and night, with and without GCE embarked. In order to reach their assigned areas, they often did their own reconnaissance before traversing improved and unimproved roads with boats, personnel and equipment. They provided their own security en route as well as during launch and recovery. Thus, the SCCo had regular, direct enemy contact and engagement in the conduct of the following waterborne tasks:[105]

- Waterway reconnaissance and combat patrol
- Waterborne raid
- Waterborne guard-post and waterborne observation post
- Hydrographic survey and bridge site survey and reconnaissance
- Counter IED ambush

105. These tasks often required extensive integration with the supporting and supported forces as well as a wide range of organic capability.

- Waterborne troop movement and insertion/extraction (including clandestine transport)
- Island clearing (search and destroy of enemy weapon caches)
- Search and recovery
- Sealing/denial of waterways
- Flank screen for GCE movement
- Outer cordon for GCE cordon and search
- Direct fire support
- Radio relay.
- Waterborne quick reaction.
- Fixing, blocking, disruption, suppression and feints.

The SCCo was able to execute many of these missions based on its resident intelligence analysis, mission planning expertise and organic infantry skills. Because many GCE commanders were unaware of their capability, they initially had to actively seek missions for themselves and aggressively pursue being assigned as mission participants. But as the operation progressed, they were requested with greater frequency as they became known as the only providers of a credible and needed riverine capability. Additionally, their participation was based on a higher headquarters' understanding that they were a self contained combat arms unit that operated small craft. This is a critical distinction because when they were tasked or when they initiated action, they naturally worked into the ground combat scheme of maneuver and could conduct combined arms maneuver warfare capably. They were able to pursue the enemy and respond to attacks during the conduct of any mission with their own organic personnel, weapons and tactics. They also were able to effectively coordinate with adjacent and supported units, as required. This is to say that the SSCo was a complete combat unit, not just the owners and operators of small craft.

An important dynamic that was observed during operations on the Euphrates river is that after the SCCo had been active in an area for several days, the enemy began to assert itself with greater frequency

and effectiveness. Essentially what seems to have occurred is that since the SCCo presence was very limited—usually a single section of 4 boats—they occupied only small areas for brief periods. Thus their arrival in an area was generally a surprise to hostile forces, insurgent and terrorists. This gave the SCCo an initial advantage and control of the area. But, as they persisted, the enemy began reacting to their presence and to assert themselves. This points to a problem inherent with small forces—establishing and maintaining battle space dominance. Since the SCCo force was too small to achieve dominance over any significant area, they had to rely on surprise and tactical agility to maintain their effectiveness. If control of the Euphrates was to be achieved for an extended period, a significantly greater number of resources, both on and off the water, was required.

In Iraq, enemy tactics that have been employed against SCCo include:

- Sniper fire
- Drive-by shooting
- Indirect fire (mortars)
- Waterborne IED
- Linear ambush from one river bank
- Coordinated linear ambush from both river banks
- Day and night combined arms attack (mortars, RPGs, small arms).

Also, in Iraq the SCCo has supported various units, including the following:

- U.S. Marines: Regimental combat teams (RCT), light armored reconnaissance battalion, and infantry battalions
- U.S. Army: Brigade combat team, combat engineer battalion, special forces group and infantry battalions
- U.S. Navy: Special warfare unit
- British: Mechanized brigade
- Iraq: Ministry of the Interior and Freedom Guard.

Employment example

In October, 2004, the SCCo supported BLT 1/2 and the 24th MEU(SOC) by providing a riverine security and raid platform along the Euphrates river. During this period, 4th platoon conducted daily patrols of the river to deter and interdict anti-Iraqi forces (AIF) activity, often taking fire from the riverbank. In each case, the platoon reacted swiftly and aggressively inflicting numerous casualties in close combat and discovered several weapon caches. While conducting one waterborne patrol on the Euphrates River, a boat section was ambushed by an unknown sized enemy force from the eastern bank. The enemy initiated contact at close range with small arms. Immediately, one RAC suppressed the target while two others attempted to beach and envelop the unseen force. Because the chosen beaching site was too shallow the boats were forced to back away from the bank in order to find another location. Just as they were backing out, they began to receive well aimed indirect fire. This prompted the section to exit the kill zone by repositioning south and call for the ground quick reaction force (QRF) to join the battle. Once the QRF arrived the boat section repositioned 400 meters north of the ambush site and inserted their organic GCE who assaulted along the river bank and through the enemy position. This ground movement was supported by close coordination of the boat sections' direct fire weapons and QRF maneuver.

Appendix D: Riverine environment

Joint Publication 1-02 defines a riverine area as an inland and coastal (delta) area comprising both land and water, characterized by limited land LOCs, with extensive water surface and/or inland waterways that provide natural routes for surface transportation and communications [29].

The latter two conditions (limited land LOCs and extensive water surface and/or waterways) may be too restrictive for our purposes. This is because once friendly forces have secured primary land LOCs, the hostile forces, insurgents, or terrorists will turn to alternative means of transportation and communication. In this sense, secondary waterways can become tactically important and must therefore be controlled.

Rivers systems and deltas are important to societies. They sustain life with food and water, support agriculture, and provide a means of transportation and energy production. Some navigable waterways support major ports and population centers. They can also act as barriers to land transportation and serve as natural boundaries between nations.

The Marine Corps Small Wars Manual and several Naval Warfare Publications highlight characteristics of a riverine environment in which operations are conducted by conventional and special operations forces [19, 32 – 35]. In 1993, Navy Special Warfare Command (NAVSPECWARCOM) published an NSW/United States Marine Corps (USMC) Riverine Operations Handbook (XL-00080-01-93) [34]. Some of the data that handbook—a tactical memorandum—are out-of-date.

This appendix discusses key information (river characteristics and climate) contained in these documents, and updates data on various river systems and deltas. We do this within the context of the Arc of Instability[106] and what is referred to as Core and non-integrating Gap,[107] which is where riverine forces might be deployed in the future.

River characteristics

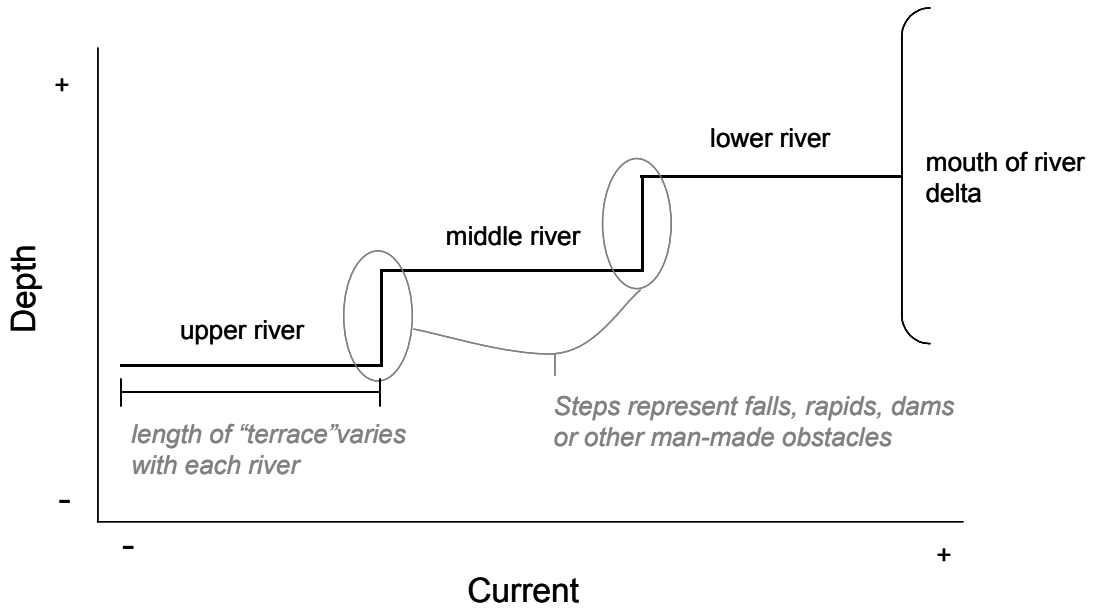
Figure 10 shows a profile of a notional river. A river can be thought of as a series of terraces (upper, middle, and lower) that originate at its head and run to its mouth. Stepping from one terrace to another is associated with water falls, rapids, or man-made obstacles such as dams. Depth of the river and velocity of the current at each terrace can differ significantly. Generally speaking, the lower river is where deeper and stronger currents are found and where deeper-draft boats

106. The arc of instability is "a swath of territory running from the Caribbean Basin through most of Africa, the Middle East, and Central and Southeast Asia. It is countries along this arc—often failed states—that U.S. officials argue have been left far behind the rest of the world in the global economy." [48]

107. Countries that embrace "globalization" fall into the functioning Core. They accept content flow and possess normative rule sets that bind countries together in mutually assured dependence associated with integrating one's national economy to the global economy. All other countries fall into the into the non-integrating Gap. This latter category defines danger and potential for military operations [27].

can operate. Also of note, at the mouth of a river or delta, its is common to have tidal variations greater than 3 meters.

Figure 10. River profile (notional)



Generally, the middle river is not as deep and currents aren't as strong as in the lower river. The terrain at the middle and upper river levels, however, can degrade line of sight as the river meanders and changes in elevation (relief) from the coast into hilly and mountainous regions.

The upper level of a river is generally very shallow and is characterized by numerous white-water rapids. Riverine boats may find the upper river unnavigable. Movement around obstructions may require land vehicles or aircraft.

The length of each terrace varies by rivers, sometimes dramatically. For example, the first natural obstacle on Africa's Congo River is only 160 kilometers from its mouth. But, the middle river extends over a 1,000 kilometers before vessels encounter impassable falls and rapids.

In contrast, ocean-going vessels can navigate China's Yangtze River for nearly 1,609 kilometers from its mouth before they reach the Yangtze Gorge [35]. The Amazon River provides another example. Large ocean-going vessels can navigate the lower river runs for almost 1,287 kilometers. Smaller ocean-going vessels (3,000 tons or smaller), with a draft of 18 feet or less, can go another 3,700 kilometers. Smaller river boats can go 780 kilometers beyond that.

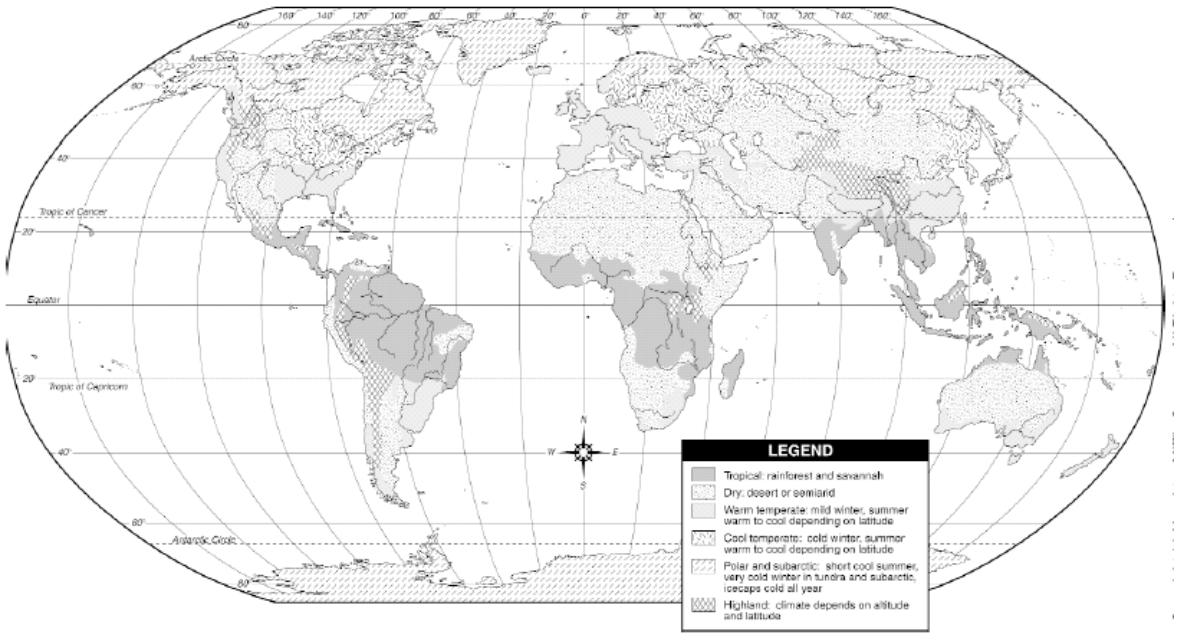
The point here is that no two rivers are the same. Each has to be examined for tidal variation, current, depth, relief, and obstacles during mission analysis. These factors and many more will determine the optimal boat characteristics and tactics to be employed in a riverine AO.

Climate

Climates vary in riverine areas, as shown in figure 11. About 50 percent of South America, 30 percent of Africa, parts of Southeast Asia, and most of Indonesia and Malaysia support tropical rainforests, which are often characterized by triple-canopy jungles in which air operations are severely restrict. Line of sight along the banks of such rivers is very restricted. It can be extremely difficult to find and fix a

potential enemy in this environment. Special equipment and tactics may be needed, to achieve battlespace dominance.

Figure 11. World climates[a]



a. Source: Houghton Mifflin Company (http://www.eduplace.com/ss/maps/pdf/world_clim.pdf)

Seasonal variation can significantly affect operations in a riverine environment. River's water level can be so low as to make it impassible, if so, waterborne operations might be restricted to the lower river. On the other hand, during the flooding season, middle and upper river levels can be navigated as though they were one level, because rapids and other obstacles are covered by several feet of water.

River systems

In 1993, the U.S. Marine Corps Intelligence Center (MCIA) examined major river systems of the world by country, excluding European

and former USSR countries. MCIA compared each country's river system to its improved road network (paved or gravel) in order to roughly measure the importance of water transportation within that country. It also looked at the potential for conflict by region and country, and assigned probabilities (unlikely, possible, probable) to the potential for U.S. military involvement in each country [34].

We've expanded on MCIA's earlier approach, updating road and waterway information, using the Central Intelligence Agency's World Fact Book [49]. We also expanded the data set to include all coastal countries and landlocked countries within 175 nautical miles from the coast.[108] For our purposes, we defined the potential scope of riverine operations by the ratio of waterways to paved roads. We used the following criteria to categorize riverine operations by scope:

- *Extensive*. Ratio of waterways to paved roads is greater than or equal to 40 percent. Note: all river deltas were considered to be "extensive".
- *Modest*. Ratio is less than 40 percent and greater than or equal to 20 percent.
- *Limited*. Ratio is less than 20 percent and greater than or equal to 2 percent.
- *Negligible*. Ratio is less than 2 percent.

If one or more deltas are located in the country, the scope of riverine operations is automatically raised one level within the above criteria. Likewise, if the delta's area is larger than 1,000 square kilometers, we considered riverine operations in this country to be "extensive."

We have not tried to replicate MCIA's approach to assigning a probability value to the threat to U.S. military operations in each country. We simply note whether a country falls within the Core or Gap as

108.North America and the polar regions were excluded from the analysis.

defined by [27]. Threats are unlikely to emerge from Core countries and somewhat likely to emerge from Gap countries.

Table 7 shows basic infrastructure data by country. Tables 8 and 9 shows our evaluation of threat and scope for riverine operations for both "Core" and Gap countries, respectively.

Table 10 – 13 show the threat and scope of riverine operations in Central Command (CENTCOM); European Command (EUCOM); Pacific Command (PACOM); and Southern Command (SOUTHCOM).

Table 7. Basic infrastructure data for riverine countries

Country	Population	Per_Capita Income (USD)	Coastline (km)	Delta	Ports and Harbors	Paved Roads (km)	Unpaved Roads (km)	Waterways (km)	Railways (km)	Paved Airports	Unpaved Airports
Albania	3,563,112	4,900	362		4	5,400	12,600	43	447	3	8
Angola	11,190,786	2,100	1600		3	5,328	46,101	1,300	2,761	32	211
Argentina	39,537,943	12,400	4989	Parana	7	63,348	152,123	11,000	34,091	144	1,190
Australia	20,090,437	30,700	25760		11	314,090	497,513	8,368	54,439	305	143
Bangladesh	144,319,628	2,000	580	Ganges	2	19,773	187,713	8,372	2,706	15	1
Belgium	10,364,388	30,600	66.5		6	116,540	32,488	2,043	3,521	25	18
Belize	279,457	6,500	386		1	488	2,384	825	-	5	38
Benin	7,460,025	1,200	121		1	1,357	5,430	150	578	1	4
Bolivia	8,857,870	2,600	0		1	3,979	56,303	10,000	3,519	16	1,049
Brazil	186,112,794	8,100	7491	Amazon, Paraiba, Sao Francisco	9	94,871	1,630,058	50,000	29,412	698	3,438
Burma	42,909,464	1,700	1930	Irrawaddy	3	3,440	24,760	12,800	3,955	9	69
Cambodia	13,607,069	2,000	443		7	1,996	10,327	2,400	602	6	14
Cameroon	16,380,005	1,900	402		2	4,288	30,012	2,090	1,008	11	36
Chile	15,980,912	10,700	6435		8	16,080	63,525	725	6,585	71	293
China	1,306,313,812	5,600	14500	Pearl, Yangtze, Huang He, Pearl	7	395,410	1,369,812	121,557	71,898	383	89
Colombia	42,954,279	6,600	3208	Magdalena	7	26,000	84,000	9,187	3,304	101	879
Congo, Democratic Republic of the	60,085,804	700	37		11	157,000	-	15,000	5,138	24	206
Congo, Republic of the	3,039,126	800	169	Congo-Zaire	6	1,242	11,558	4,385	894	4	28
Costa Rica	4,016,173	9,600	1290		2	4,236	31,067	730	278	30	119
Cote d'Ivoire	17,298,040	1,500	515		0	4,889	45,511	980	660	-	-
Croatia	4,495,904	11,200	5835		5	23,979	4,365	785	2,726	23	45

Table 7. Basic infrastructure data for riverine countries (continued)

Country	Population	Per_Capita Income (USD)	Coastline (km)	Delta	Ports and Harbors	Paved Roads (km)	Unpaved Roads (km)	Waterways (km)	Railways (km)	Paved Airports	Unpaved Airports
Cuba	11,346,670	3,000	3735		3	29,820	31,038	240	4,226	79	91
Denmark	5,432,335	32,200	7314		13	71,847	-	417	2,628	28	69
Ecuador	13,363,593	3,700	2237		5	8,164	35,044	1,500	966	62	143
Egypt	77,505,756	4,200	2450	Nile	6	49,984	14,016	3,500	5,063	72	15
El Salvador	6,704,932	4,900	307		2	1,986	8,043	100	283	4	69
Equatorial Guinea	535,881	2,700	296		1	2,880	-	105	-	3	1
Estonia	1,332,893	14,300	3794		5	13,874	42,070	500	958	14	15
Finland	5,223,442	29,000	1250		10	50,539	27,658	7,842	5,851	75	73
France	60,656,178	28,700	3427	Rhone, Rhine	10	893,100	-	8,500	29,512	283	195
French Guiana	195,506	8,300	378		1	817	-	3,760	-	4	7
Gabon	1,389,201	5,900	885		5	838	7,626	1,600	814	11	45
Gambia, The	1,593,256	1,800	80		1	956	1,744	390	-	1	-
Georgia	4,677,401	3,100	310		2	18,914	1,315	45	1,612	17	13
Germany	82,431,390	28,700	2389		10	230,735	-	7,300	46,142	331	219
Ghana	21,029,853	2,300	539		2	8,496	37,670	1,293	953	7	5
Greece	10,668,354	21,300	13676		6	107,406	9,594	6	2,571	66	14
Guatemala	14,655,189	4,200	400		2	4,871	9,247	990	886	11	441
Guinea	9,467,866	2,100	320		1	5,033	25,467	1,295	837	5	11
Guinea-Bissau	1,416,027	700	350		4	453	3,947	130	-	3	25
Haiti	8,121,622	1,500	1771		1	1,011	3,149	100	-	4	9
Honduras	6,975,204	2,800	820		4	2,775	10,828	465	699	11	104
India	1,080,264,388	3,100	7000	Godavari, Krishna, Mahanadi, Penner	8	1,448,655	1,077,334	14,500	63,230	234	99
Indonesia	241,973,879	3,500	54716	Brahmani	10	158,670	184,030	21,579	6,458	154	513
Iran	68,017,860	7,700	2440		2	94,109	73,048	850	7,203	127	178
Iraq	26,074,906	2,100	58		3	38,399	7,151	5,275	2,200	79	32
Italy	58,103,033	27,700	7600	Po	8	479,688	-	2,400	19,319	96	38
Korea, North	22,912,177	1,700	2495		12	1,997	29,203	2,250	5,214	35	43

Table 7. Basic infrastructure data for riverine countries (continued)

Country	Population	Per_Capita Income (USD)	Coastline (km)	Delta	Ports and Harbors	Paved Roads (km)	Unpaved Roads (km)	Waterways (km)	Railways (km)	Paved Airports	Unpaved Airports
Korea, South	48,422,644	19,200	2413		0	66,721	20,269	1,608	3,472	-	-
Laos	6,217,141	1,900	0		0	9,664	12,052	4,600	-	9	35
Latvia	2,290,237	11,500	531		2	57,206	3,265	300	2,303	26	24
Liberia	3,482,211	900	579		2	657	9,943	160	490	2	51
Lithuania	3,596,617	12,500	99		1	69,202	7,946	600	1,998	28	74
Luxembourg	468,571	58,900	0		1	5,210	-	37	274	1	1
Macedonia	2,045,262	7,100	0		0	5,540	3,144	10	699	10	7
Madagascar	18,040,341	800	4828	Betsiboka, Mangoky	3	5,780	44,047	600	732	29	87
Malaysia	23,953,136	9,700	4675	Baram, Kelang	9	51,318	14,559	7,200	1,890	38	79
Mauritania	3,086,859	1,800	754		2	866	6,794	300	717	8	16
Mexico	106,202,903	9,600	9330		7	108,087	221,445	2,900	17,634	233	1,600
Mozambique	19,406,703	1,200	2470	Pungue, Zambezi	0	5,685	24,715	460	3,123	-	-
Netherlands	16,407,491	29,500	451		7	104,850	11,650	5,046	2,808	20	7
Nicaragua	5,465,100	2,300	910	Rio Punta Gorda	3	2,126	16,586	2,200	6	11	165
Nigeria	128,771,988	1,000	853	Niger	4	60,068	134,326	8,600	3,557	36	34
Norway	4,593,041	40,000	25148		8	71,185	20,667	500	4,077	65	36
Pakistan	162,419,946	2,200	1046	Indus	3	152,033	105,650	-	8,163	92	39
Panama	3,039,150	6,900	2490		3	4,028	7,615	800	355	44	61
Papua New Guinea	5,545,268	2,200	5152		3	686	18,914	10,940	-	21	550
Peru	27,925,628	5,600	2414		5	10,452	67,788	8,808	3,462	52	182
Philippines	87,857,473	5,000	36289		7	19,202	182,922	3,219	897	82	173
Poland	38,635,144	12,000	491		4	249,088	115,609	3,997	23,852	84	39
Portugal	10,566,212	17,900	1793		4	14,736	2,399	210	2,850	42	23
Romania	22,329,977	7,700	225	Danube	4	100,173	98,582	1,731	11,385	25	36

Table 7. Basic infrastructure data for riverine countries (continued)

Country	Population	Per_Capita Income (USD)	Coastline (km)	Delta	Ports and Harbors	Paved Roads (km)	Unpaved Roads (km)	Waterways (km)	Railways (km)	Paved Airports	Unpaved Airports
Russia	143,420,309	9,800	37653	Pechora, Volga, Amu-Darya, Lena, Yenisey	10	362,133	175,156	96,000	87,157	577	2,009
Senegal	11,126,832	1,700	531	Senegal	1	4,271	10,305	1,000	906	9	11
Sierra Leone	6,017,643	600	402		3	904	10,396	800	-	1	9
Spain	40,341,462	23,300	4964	Ebro	8	658,203	6,649	1,045	14,781	95	61
Sri Lanka	20,064,776	4,000	1340		2	11,068	582	160	1,449	13	1
Sudan	40,187,486	1,900	853		1	4,320	7,580	4,068	5,995	12	63
Suriname	438,144	4,300	386		1	1,168	3,324	1,200	-	5	41
Swaziland	1,173,900	5,100	0		0	3,107	-	80	301	1	17
Sweden	9,001,774	28,400	3218		9	167,604	45,633	250	11,481	154	100
Syria	18,448,752	3,400	193		2	6,489	39,208	900	2,711	26	66
Tanzania	36,766,356	700	1424	Rufiji	3	3,704	84,496	320	3,690	11	112
Thailand	65,444,371	8,100	3219	Chao Phraya	4	56,542	861	4,000	4,071	65	44
Togo	5,681,519	1,600	56		2	2,376	5,144	50	568	2	7
Turkey	69,660,559	7,400	7200		8	147,404	207,017	1,200	8,697	87	32
Ukraine	47,425,336	6,300	2782	Dniepr	8	164,249	5,430	1,672	22,473	174	482
United Kingdom	60,441,457	29,600	12429		8	392,931	-	3,200	17,274	334	137
United States	295,734,134	40,100	19924		12	4,180,053	2,213,550	41,009	227,736	5,128	9,729
Uruguay	3,415,920	14,500	660		1	8,081	902	1,600	2,073	14	50
Venezuela	25,375,281	5,800	2800	Orinoco	5	32,308	63,847	7,100	682	127	242
Vietnam	83,535,576	2,700	3444	Mekong, Red	2	23,418	69,882	17,702	2,600	21	3

Table 8. Core riverine countries (less North America/Polar regions), ranked by ratio of waterways to paved roads

Country	Threat	Scope of Riverine Ops	Modified Scope of Riverine Ops[a]	Delta	Paved Roads (km)	Waterways (km)	Ratio of waterways to paved roads
Brazil	Unlikely	Extensive	Extensive	Amazon, Paraiba, Sao Francisco	94,871	50,000	52.7%
China	Unlikely	Modest	Extensive (D)	Pearl, Yangtze, Huang He, Pearl	395,410	121,557	30.7%
Russia	Unlikely	Modest	Extensive (D)	Pechora, Volga, Amu-Darya, Lena, Yenisey	362,133	96,000	26.5%
Uruguay	Unlikely	Limited	Limited		8,081	1,600	19.8%
Argentina	Unlikely	Limited	Extensive (D)	Parana	63,348	11,000	17.4%
Finland	Unlikely	Limited	Limited		50,539	7,842	15.5%
Netherlands	Unlikely	Negligible	Negligible		104,850	5,046	4.8%
Chile	Unlikely	Negligible	Negligible		16,080	725	4.5%
Estonia	Unlikely	Negligible	Negligible		13,874	500	3.6%
Germany	Unlikely	Negligible	Negligible		230,735	7,300	3.2%
Mexico	Unlikely	Negligible	Negligible		108,087	2,900	2.7%
Australia	Unlikely	Negligible	Negligible		314,090	8,368	2.7%
Korea, South	Unlikely	Negligible	Negligible		66,721	1,608	2.4%
Belgium	Unlikely	Negligible	Negligible		116,540	2,043	1.8%
Romania	Unlikely	Negligible	Extensive (D)	Danube	100,173	1,731	1.7%
Poland	Unlikely	Negligible	Negligible		249,088	3,997	1.6%
Portugal	Unlikely	Negligible	Negligible		14,736	210	1.4%
Ukraine	Unlikely	Negligible	Modest (D)	Dniepr	164,249	1,672	1.0%
India	Unlikely	Negligible	Extensive (D)	Godavari, Krishna, Mahanadi, Penner	1,448,655	14,500	1.0%
United States	Unlikely	Negligible	Extensive (D)		4,180,053	41,009	1.0%
France	Unlikely	Negligible	Modest (D)	Rhone, Rhine	893,100	8,500	1.0%
Lithuania	Unlikely	Negligible	Negligible		69,202	600	0.9%
United Kingdom	Unlikely	Negligible	Negligible		392,931	3,200	0.8%
Luxembourg	Unlikely	Negligible	Negligible		5,210	37	0.7%
Norway	Unlikely	Negligible	Negligible		71,185	500	0.7%

Table 8. Core riverine countries (less North America/Polar regions), ranked by ratio of waterways to paved roads (continued)

Country	Threat	Scope of Riverine Ops	Modified Scope of Riverine Ops[a]	Delta	Paved Roads (km)	Waterways (km)	Ratio of waterways to paved roads
Denmark	Unlikely	Negligible	Negligible		71,847	417	0.6%
Latvia	Unlikely	Negligible	Negligible		57,206	300	0.5%
Italy	Unlikely	Negligible	Extensive (D)	Po	479,688	2,400	0.5%
Georgia	Unlikely	Negligible	Negligible		18,914	45	0.2%
Spain	Unlikely	Negligible	Modest (D)	Ebro	658,203	1,045	0.2%
Sweden	Unlikely	Negligible	Negligible		167,604	250	0.1%
Greece	Unlikely	Negligible	Negligible		107,406	6	0.0%

a. (D) represents a riverine scope adjustment based on criteria delta size and presence within a country highlighted earlier. See next section for information on delta characteristics.

Table 9. Gap riverine countries (less North America/Polar regions), ranked by ratio of waterways to paved roads

Country	Threat	Scope of Riverine Ops	Modified Scope of Riverine Ops	Delta	Paved Roads (km)	Waterways (km)	Ratio of waterways to paved roads
Papua New Guinea	Potential Exists	Extensive	Extensive		686	10,940	1594.8%
French Guiana	Potential Exists	Extensive	Extensive		817	3,760	460.2%
Burma	Potential Exists	Extensive	Extensive	Irrawaddy	3,440	12,800	372.1%
Congo, Republic of the	Potential Exists	Extensive	Extensive	Congo-Zaire	1,242	4,385	353.1%
Bolivia	Potential Exists	Extensive	Extensive		3,979	10,000	251.3%
Gabon	Potential Exists	Extensive	Extensive		838	1,600	190.9%
Belize	Potential Exists	Extensive	Extensive		488	825	169.1%
Cambodia	Potential Exists	Extensive	Extensive		1,996	2,400	120.2%
Korea, North	Potential Exists	Extensive	Extensive		1,997	2,250	112.7%
Nicaragua	Potential Exists	Extensive	Extensive	Rio Punta Gorda	2,126	2,200	103.5%
Suriname	Potential Exists	Extensive	Extensive		1,168	1,200	102.7%
Sudan	Potential Exists	Extensive	Extensive		4,320	4,068	94.2%
Sierra Leone	Potential Exists	Extensive	Extensive		904	800	88.5%

Table 9. Gap riverine countries (less North America/Polar regions), ranked by ratio of waterways to paved roads (continued)

Country	Threat	Scope of Riverine Ops	Modified Scope of Riverine Ops	Delta	Paved Roads (km)	Waterways (km)	Ratio of waterways to paved roads
Peru	Potential Exists	Extensive	Extensive		10,452	8,808	84.3%
Vietnam	Potential Exists	Extensive	Extensive	Mekong, Red	23,418	17,702	75.6%
Cameroon	Potential Exists	Extensive	Extensive		4,288	2,090	48.7%
Laos	Potential Exists	Extensive	Extensive		9,664	4,600	47.6%
Bangladesh	Potential Exists	Extensive	Extensive	Ganges	19,773	8,372	42.3%
Gambia, The	Potential Exists	Extensive	Extensive		956	390	40.8%
Colombia	Potential Exists	Modest	Extensive (D)	Magdalena	26,000	9,187	35.3%
Mauritania	Potential Exists	Modest	Modest		866	300	34.6%
Guinea-Bissau	Potential Exists	Modest	Modest		453	130	28.7%
Guinea	Potential Exists	Modest	Modest		5,033	1,295	25.7%
Angola	Potential Exists	Modest	Modest		5,328	1,300	24.4%
Liberia	Potential Exists	Modest	Modest		657	160	24.4%
Senegal	Potential Exists	Modest	Extensive (D)	Senegal	4,271	1,000	23.4%
Venezuela	Potential Exists	Modest	Extensive (D)	Orinoco	32,308	7,100	22.0%
Guatemala	Potential Exists	Modest	Modest		4,871	990	20.3%
Cote d'Ivoire	Potential Exists	Modest	Modest		4,889	980	20.0%
Panama	Potential Exists	Limited	Limited		4,028	800	19.9%
Ecuador	Potential Exists	Limited	Limited		8,164	1,500	18.4%
Costa Rica	Potential Exists	Limited	Limited		4,236	730	17.2%
Philippines	Potential Exists	Limited	Limited		19,202	3,219	16.8%
Honduras	Potential Exists	Limited	Limited		2,775	465	16.8%
Ghana	Potential Exists	Limited	Limited		8,496	1,293	15.2%
Nigeria	Potential Exists	Limited	Extensive (D)	Niger	60,068	8,600	14.3%
Malaysia	Potential Exists	Limited	Modest (D)	Baram, Kelang	51,318	7,200	14.0%
Syria	Potential Exists	Limited	Limited		6,489	900	13.9%
Iraq	Potential Exists	Limited	Extensive (D)		38,399	5,275	13.7%
Indonesia	Potential Exists	Limited	Modest (D)	Brahmani	158,670	21,579	13.6%
Benin	Potential Exists	Limited	Limited		1,357	150	11.1%
Madagascar	Potential Exists	Limited	Modest (D)	Betsiboka, Mangoky	5,780	600	10.4%
Haiti	Potential Exists	Limited	Limited		1,011	100	9.9%

Table 9. Gap riverine countries (less North America/Polar regions), ranked by ratio of waterways to paved roads (continued)

Country	Threat	Scope of Riverine Ops	Modified Scope of Riverine Ops	Delta	Paved Roads (km)	Waterways (km)	Ratio of waterways to paved roads
Congo, Democratic Republic of the	Potential Exists	Limited	Limited		157,000	15,000	9.6%
Tanzania	Potential Exists	Limited	Modest (D)	Rufiji	3,704	320	8.6%
Mozambique	Potential Exists	Limited	Extensive (D)	Pungue, Zambezi	5,685	460	8.1%
Thailand	Potential Exists	Limited	Modest (D)	Chao Phraya	56,542	4,000	7.1%
Egypt	Potential Exists	Limited	Modest (D)	Nile	49,984	3,500	7.0%
El Salvador	Potential Exists	Limited	Limited		1,986	100	5.0%
Equatorial Guinea	Potential Exists	Negligible	Negligible		2,880	105	3.6%
Croatia	Potential Exists	Negligible	Negligible		23,979	785	3.3%
Swaziland	Potential Exists	Negligible	Negligible		3,107	80	2.6%
Togo	Potential Exists	Negligible	Negligible		2,376	50	2.1%
Sri Lanka	Potential Exists	Negligible	Negligible		11,068	160	1.4%
Iran	Potential Exists	Negligible	Negligible		94,109	850	0.9%
Turkey	Potential Exists	Negligible	Negligible		147,404	1,200	0.8%
Cuba	Potential Exists	Negligible	Negligible		29,820	240	0.8%
Albania	Potential Exists	Negligible	Negligible		5,400	43	0.8%
Macedonia	Potential Exists	Negligible	Negligible		5,540	10	0.2%
Pakistan	Potential Exists	Negligible	Modest (D)	Indus	152,033	-	0.0%

Table 10. CENTCOM, threat vs. scope of riverine operations

Potential for riverine operations	Scope of riverine operation			
	Extensive	Modest	Limited	Negligible
Potential Exists	Iraq	Egypt		Iran
"	Sudan	Pakistan		

Table 11. EUCOM, threat vs. scope of riverine operations

Potential for riverine operations	Scope of riverine operation			
	Extensive	Modest	Limited	Negligible
Unlikely	Italy	France	Finland	Belgium
"	Romania	Spain		Denmark
"	Russia	Ukraine		Estonia
"				Georgia
"				Germany
"				Greece
"				Latvia
"				Lithuania
"				Luxembourg
"				Netherlands
"				Norway
"				Poland
"				Portugal
"				Sweden
"				United Kingdom
Potential Exists	Cameroon	Angola	Benin	Albania
"	Congo, Republic of the	Cote d'Ivoire	Congo, Democratic Republic of the	Croatia
"	Gabon	Guinea	Ghana	Equatorial Guinea
"	Gambia, The	Guinea-Bissau	Syria	Macedonia
"	Mozambique	Liberia		Swaziland
"	Nigeria	Mauritania		Togo
"	Senegal	Tanzania		Turkey
"	Sierra Leone			

Table 12. PACOM, threat vs. scope of riverine operations

Potential for riverine operations	Scope of riverine operation			
	Extensive	Modest	Limited	Negligible
Unlikely	China			Australia
"	India			Korea, South
Potential Exists	Bangladesh	Indonesia	Philippines	Sri Lanka
"	Burma	Madagascar		
"	Cambodia	Malaysia		
"	Korea, North	Thailand		
"	Laos			
"	Papua New Guinea			
"	Vietnam			

Table 13. SOUTHCOM, threat vs. scope of riverine operation

Potential for riverine operations	Scope of riverine operation			
	Extensive	Modest	Limited	Negligible
Unlikely	Argentina		Uruguay	Chile
"	Brazil			
Potential	Belize	Guatemala	Costa Rica	
"	Bolivia		Ecuador	
"	Colombia		El Salvador	
"	French Guiana		Haiti	
"	Nicaragua		Honduras	
"	Peru		Panama	
"	Suriname			
"	Venezuela			

River deltas

This section lists major delta systems falling within riverine countries. We show the river basins and deltas measured in square kilometers. The Mekong River Delta is almost 94,000 square kilometers. This is an important benchmark because over 500 riverine craft, helicopters (UH-1), fixed-wing aircraft (OV-10)and shore and afloat bases were on the inland waterways of South Vietnam in 1971. In fact, over 9000 U.S. Navy officers and enlisted men were in the frontline coastal and

riverine units. Also, for every person in the frontline units, there were about 2.5 in support of the riverine operation. This is a useful sizing metric for one of our capabilities sets presented later in this report.

Of special note, the Ganges-Brahmaputra Delta in Bangladesh is 12 percent larger than the Mekong River Delta system. Additionally, within Gap riverine countries, there are several delta systems over 4,000 square kilometers (sq km). These are listed below.[109]

- Ganges-Brahmaputra (Bangladesh/India): 105,640 sq km
- Mekong (Vietnam): 93,781 sq km
- Orinoco (Venezuela): 20,642 sq km
- Irrawaddy (Burma): 20,571 sq km
- Niger (Nigeria): 19,720 sq km (est)
- Shatt al Arab (Iraq/Iran): 18,479 sq km
- Red (Vietnam): 12,073 sq km
- Indus (Pakistan): 4,800 sq km (est)
- Senegal (Senegal): 4,254 sq km

Not all deltas are defined in our data set. Information on the smaller deltas is not documented in current literature. To flesh out our database, we would need to survey each delta using overhead imagery and perhaps visit some of these systems, which is beyond the scope of this study. Still, we have enough information to help us formulate capability sets. We can even use river basins as a rough proxy.[110]

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109. There may be others. Information for each delta system is unavailable. Size of the drainage basin is available but it is not a good metric since drainage basin include several countries.

110. A river basin is the land area drained by a river and its tributaries.

When we examine river basins and compare these to the Mekong river basin, we find 18 systems larger than the Mekong—eight in Gap countries: Congo-Zaire, Nile, Niger, Ganges, Zambezi, Indus, Shatt al Arab, and Orinoco. We need to keep this in mind when we consider capability sets.

Table 14 lists some characteristics of major river deltas. A delta is usually formed at the mouth of a river but can be located inland.

Table 14. River delta systems

Delta	Drainage Basin (sq km)	Delta (sq km)	Average Annual Rainfall (inches)	Peak Annual Rainfall (inch)	Delta Remarks	Ref
Amazon	5,883,400	Unkown	Unkown	Unkown	The Amazon is 270 km wide at the mouth. In flood conditions, the river is 40m deep and 25m miles wide. The main river (which is usually between one and six miles wide) is navigable for large ocean steamers for almost 1287 km (800 miles) upriver from the mouth. Smaller ocean vessels of 3,000 tons with a draft of 18 feet can reach as far as 3,700 km (2,300 miles) from the sea. Smaller riverboats can reach another 780 km (486 mi) higher as far as Achual Point. Beyond that, small boats frequently ascend to the Pongo de Manseriche, just above Achual Point.	[50, 51]
Amu-Darya	2,085,900	64,000	18	79		[50, 51]
Baram	Unkown	208	127	Unkown	High wave action	[50, 51]
Betsiboka	Unkown	Unkown	Unkown	Unkown	Madagascar	[50, 51]
Brahmani	Unkown	Unkown	Unkown	Unkown		[50, 51]
Chao Phraya	992,000	Unkown	Unkown	Unkown	The Basin covers 30% of Thailand's land area, is home to 40% of the country's population, employs 78% of its work force, and generates 66% of its Gross Domestic Product (GDP). The total population of the Chao Phraya basin was 23.0 million inhabitants in 1996.	[50, 51]
Congo-Zaire	3,691,000	Unkown	Unkown	Unkown		[50, 51]
Danube	899,000	4,345	32	66	The Danube is the second largest river in Europe; it is approximately 2,900 km long and drains an area slightly larger than 779,500 sq km.	[50, 51]
Dneiper	516,300	Unkown	19	25	The Dneiper River is one of the longest rivers in Europe, some 2,300 km long; since the construction (1932) of the Dniprohes dam, the Dniepr is navigable for virtually its entire course and discharge is more controlled; delta basin is frozen about half of the year.	[50, 51]
Ebro	85,800	Unkown	Unkown	Unkown		[50, 51]
Ganges-Brahmaputra	1,634,900	105,640	58	89	The delta is one of the largest in the world. More than 143 million people live in this area. It covers 105,640 sq km and has one of the highest population densities of all deltas; the mean tidal range is 3.6 meters.	[50, 51]
Huang He	865,100	Unkown	12	30	River has a total length of 5,464 km; More than 100 million people live along the banks of the Huang He (Yellow River).	[50, 51]
Indus	1,138,800		16	62		[50, 51]
Irrawaddy	404,200	20,571	66	139	Tropical rainforest; mangrove forest cover is dense and dominates the vegetation in the lower delta	[50, 51]
Kelang	Unkown	Unkown	Unkown	Unkown		[50, 51]
Lena	3,028,000	Unkown	16	28		[50, 51]

Table 14. River delta systems (continued)

Delta	Drainage Basin (sq km)	Delta (sq km)	Average Annual Rainfall (inches)	Peak Annual Rainfall (inch)	Delta Remarks	Ref
Magdelena	241,000	1,689	72	129	Navigable for about 990 km upstream from the inland port of Honda to the Caribbean coast, the river is the principal route to the interior of Colombia.	[50, 51]
Mangoky	58,155	124	33	74	From its headwaters to the delta mouth, the main channel has a length of 570 km; 54,383 acres of delta plain was being utilized by man,	[50, 51]
Mekong	787,800	93,781	51	89	The Mekong delta covers an area of 93,781 km2 in Vietnam; population density is extremely dense along the river course and population density is quite high, density ranging from 3 to 18 people per sq km.	[50, 51]
Mkuzi	Unkown	Unkown	Unkown	Unkown		[50, 51]
Niger	2,113,200	Unkown	26	89	Main course of the Niger river has a length of 4,350 km from its headwaters to the mouths of the delta; it is densely populated. Ofter referred to as the Oil Rivers; Africa's largest produce of petroleum.	[50, 51]
Nile	3,031,700	Unkown	Unkown	Unkown	Begins slightly down river of Cairo. 3000 people per sq km.	[50, 51]
Orange	945,500	Unkown	Unkown	Unkown		[50, 51]
Orinoco	958,500	20,642	79	152		[50, 51]
Parana	2,966,900	5,440	51	78		[50, 51]
Pariba	Unkown	Unkown	Unkown	Unkown		[50, 51]
Pearl	Unkown	Unkown	Unkown	Unkown		[50, 51]
Pechora	300,700	8,737	19	28		[50, 51]
Penner	55,200	Unkown	20	35	The total length is about 560 km, draining some 55,200 sq km.	[50, 51]
Po	87,100	13,398	46	76		[50, 51]
Punque	32,711	Unkown	44	54	Mozambique; main channel of the river is some 390 km in length	[50, 51]
Red	164,600	12,073	37	56	Vietnam; With a population of almost 17 million people living in the delta, the Red River Delta is one of the most densely populated rural areas in the world, with about 1,000-persons/ sq km.	[50, 51]
Rhine	172,900	Unkown	Unkown	Unkown		[50, 51]
Rhone (Camargue)	100,200	3,446	Unkown	Unkown		[50, 51]
Rufiji	Unkown	Unkown	Unkown	Unkown		[50, 51]
Sao Fancisco	602,300	1,742	76	Unkown		[50, 51]
Senegal	437,000	4,254	26	75	Several dams have been constructed in the northern part of the basin, forming small lakes, and provide the only source of fresh water for irrigation. The main channel of the Senegal flows from its headwaters in the southern part of the basin for a distance of 1,190 km before entering the Atlantic Ocean.	[50, 51]

Table 14. River delta systems (continued)

Delta	Drainage Basin (sq km)	Delta (sq km)	Average Annual Rainfall (inches)	Peak Annual Rainfall (inch)	Delta Remarks	Ref
Shatt al Arab	1,114,000	18,479	Unkown	Unkown		[50, 51]
Volga	1,554,900	27,224	25	33	The Volga River has the largest river system (2,365 km) in Europe.	[50, 51]
Yangtze	1,354,200	66,669	47	75	Delta is 40,000 sq km.	[50, 51]
Yenisey	Unkown	Unkown	Unkown	Unkown		[50, 51]
Zambezi	1,385,300	2,705	38	60	Many dams to hold fresh water.	[50, 51]

Appendix E: Mine threats to USN riverine forces and means of countering them

Introduction

The rebirth of USN riverine forces marks an important shift in naval operating areas, potentially contributing to USN operations inland. Like the Navy's ongoing shift in emphasis from blue-water combat to littoral operations, addressing the opportunities and challenges of the riverine environment requires new analysis of forces' capabilities and vulnerabilities. In this appendix, we examine a particular force protection threat, namely the use of naval mines to attrite, delay, or disrupt riverine operations. Moreover, we look at some of the ways in which the USN can counter such threats.

Naval mine threat in the riverine environment

The boats used for riverine operations could be extremely vulnerable to the use of naval mines (including improvised, watertight IEDs). We begin by characterizing the threat. Generally speaking, mines and IEDs are detonated via one or more of the following mechanisms:

- Direct contact with the target
- Influence sensors (e.g., mines that detonate in response to changes in the local magnetic field, indicating the presence of a ship)
- Time-delayed fuses
- Remote control.

In the case of a riverine environment, contact and remotely controlled mines comprise the most likely threats. The use of time-delayed mines would require a precise knowledge of when a boat

would be in the vicinity of the mine, while a boat's limited magnetic, acoustic, and pressure signatures might not be large enough to detonate any but the most sensitive influence mines.

Contact mines are always at least partly buoyant (to remain close to the surface of the water), and they can either be moored or drifting. Moored contact mines are attached to an anchor which essentially fixes them in place, anticipating that a boat will strike them and cause detonation. Lines or fields of such mines can be laid along a riverbed to create a zone in which a boat is likely to become a mine casualty. Drifting mines can be released upriver and allowed to flow downstream with the current, allowing for possible collision with boats. This is a more haphazard approach, but also one which is particularly difficult to counter, as we will see in a later section.

Remotely controlled naval mines or IEDs are essentially the same as hard-wired IEDs on land. Obviously, the mine and its cable need to be watertight, while the cable needs to extend to a position where the person detonating it can do so in a concealed manner (e.g., amidst foliage along an elevated riverbank). A single person can spot the boat and also detonate the mine, or the information that the boat is passing can be relayed from a spotter to a different person activating the remote control. Remotely controlled IEDs could also be placed along the riverbank, if the explosive charge were sufficiently large to damage boats towards the middle of the waterway.

Contact mines, whether drifting or moored, would be relatively non-discriminating among boats transiting along the river. As such, they would be likely to hinder all river traffic. They could also detonate in response to contact with flotsam or (in the case of drifting mines) the riverbank, potentially limiting their utility. On the other hand, remotely controlled mines could be used to target boats very selectively, damaging USN riverine forces while allowing for other traffic.

All types of naval mines and IEDs are readily available on world markets, and/or can be easily manufactured. Hard-wired IEDs, like those used by the sides of Iraqi roads, can be used as remotely controlled naval mines simply by making them watertight. Contact mines can be bought from a variety of suppliers, or manufactured by placing explosive charges into buoyant containers and setting the fusing so that

they will detonate if a certain amount of force is applied to a portion of the mine.

Minelaying is generally an easy task for low-technology forces. Small mines, such as those which are likely to be used in rivers, can be tossed off the backs of boats or hand-carried by groups of waders. The only sophistication required is that to ensure that the mine is not prematurely detonated during the handling process.

Compared with hardened warships, boats are relatively vulnerable to mine damage. A boat that is subjected to the pressure of an explosion, and/or lacerating material breaching the surface, is likely to be severely damaged or sunk. Its personnel are also at risk, particularly if they are not protected by armor. The physics of underwater explosions differs in rivers from that in open or deeper water. An explosion may reverberate against the bottom and/or sides of the river, or much of the explosive energy may be directed upwards into the air. As such, the precise manner and extent to which a mine can damage a boat is highly dependent upon the situation; it will be a strong function of the environment, the size of the explosive charge, the boat's durability, and the mine's location relative to particular portions of the boat. On the other hand, the probability that a mine detonating in close proximity to the boat inflicts mission-abort damage can be characterized as high.

Riverine naval mines could easily be used in concert with other methods of attack. For example, an attacker could allow USN riverine forces to experience mine damage, then shoot survivors from concealed, elevated positions along a riverbank. They could also fire mortars or other large-scale weapons at the survivors from more remote locations. Rescue teams, reinforcements, and mine clearance assets could also be ambushed.

Generally speaking, the threat from riverine mines is exacerbated relative to that in open waters. There are several reasons for this. The first is that a river entails movement in restricted water space, in which boats are essentially confined to a single dimension; predicting the path they will follow, and hence the best places to lay mines, is easier than in two-dimensional water space. A second reason is the previously cited high vulnerability of boats to damage. The third reason is

that minelaying operations can often be concealed by the high density of river traffic, making mining especially difficult to detect.

Mining a river, or claiming to have done so, could also disrupt and delay operations even without causing a single casualty. If U.S. forces were aware of possible mining, they might wait for countermeasures to be undertaken before undertaking specific operations, to the detriment of overall mission capabilities. Mining a river with contact mines could also have a deleterious effect on a local economy, undermining U.S. promises of security and exacerbating tensions in ways that were harmful to U.S. interests.

Countering riverine mine threats

Unfortunately, as with mine threats in general, there is no panacea that can comprehensively overcome the riverine mine threat. There are several distinct approaches, all of which have significant limitations.

Intelligence, surveillance, and reconnaissance

ISR data can emerge from a broad spectrum of sources, such as HUMINT reports that an area may be mined, unmanned aerial vehicle (UAV) imagery of insurgents placing mines in the water, or a visible cable leading from the river up onto an embankment. Unfortunately, such data is often not available or reliable. There is unlikely to be continuous, high-resolution imagery coverage of an entire river (particularly at night or in adverse weather conditions). Even when it is available, imagery may be unable to distinguish minelaying from discarding refuse or setting out fishing gear. HUMINT is frequently inaccurate. Furthermore, ISR must be made actionable rapidly to foster interdiction and mine avoidance.

ISR can also include environmental data regarding the river. Key parameters include bathymetry (indicating where boats of with a particular draft can go), riverbank topography and opportunities for concealment, and underwater visibility (which can affect the ability of boats to avoid and/or clear mines). Variations in the river depth as a function of time can also influence whether moored contact mines

are effective. If the water becomes significantly deeper than the mooring cable due to seasonal, weather, or diurnal changes, the boat may be able to pass over the mine without detonating it. The speed and variability of the river's currents can also influence mine effectiveness, by causing moored mines to deviate from a vertical direction, and/or by causing drifting mines to crash into embankments or flotsam.

ISR can also aid in detecting mines that are already present. Contact mines that breach the surface, or are visible through translucent water, can be detected. If the water is relatively shallow and visibility is good, bottom and remotely controlled IEDs may be visible. ISR can also be used to discern a remotely controlled IED's underwater cables snaking onto an embankment where a person is stationed.

Mine clearance

If a river has been mined, several types of countermeasures can be taken. Near-surface contact mines, if visible from a helicopter or shoreline, can be shot with various types of weapons systems. Shooting the mine can either cause it to detonate (thereby removing the threat) or sink (so that the mine is no longer a contact threat to boats, although it conceivably remains a hazard to civilian bottom fishing and the like). Divers, dolphins, and/or mine neutralization vehicles (MNVs) can attach a charge to moored mines, causing them to detonate or sink.

If remotely controlled bottom mines are being used, unmanned undersea vehicles (UUVs) can be used to scan the bottom with sonar and find mines. Unfortunately, in well-used river environments, they are likely to discern a large number of contacts, most of which would be discarded objects; reacquiring and identifying these contacts could be prohibitively time-consuming. However, if the effort were sufficiently important, they could be reacquired and identified by divers, dolphins, or MNVs.

In some cases, MCM helicopters and shallow-draft boats may be used to sweep mines. Principal risks include the threat off shore-base attack against minesweepers, as well as threat of damage from the

mines themselves.[111] That said, existing sweep gear may be too cumbersome and expansive for some riverine environments. Moreover, MCM helicopters are in short supply; there are only 19 in the entire USN, and they are subject to frequent mechanical breakdown.

Targeting remote control cables and personnel ashore, UAVs and other imagery assets could scout ahead of riverine patrols to look out for a variety of possible threats, including cables and personnel associated with remotely controlled mines. The personnel and/or the cables could then be targeted with weapons aboard the UAV, or by reinforcements sent from nearby bases.

Waiting for drifting mines to pass

Drifting mines in a river are necessarily a temporary threat, rather than a persistent one. Unless drifting mines are being continually reseeded, waiting for currents to take them out to sea, or detonate in collisions with the riverbank, may be a viable way of avoiding damage.

In-stride mine avoidance

Since contact mines need to be near the surface to strike shallow-draft boats, a boat may be able to see and avoid them while transiting. This applies to both contact and drifting mines. Visibility in both air and water are critical to the success of this tactic, so it will depend heavily on the weather and water conditions. Reporting that mines are present, and the global positioning system (GPS) locations of moored contact mines, could be of use to MCM forces and subsequent riverine patrols.

111. MCM helicopters have the disadvantage of being vulnerable to attack as they fly at low elevations and in predictable patterns along a river. RPGs and other forms of shore-based fires could easily cause them to be damaged to the point of aborting their missions, if not causing outright crashes. Small boats are also vulnerable to attack.

Conclusions

River mines and IEDs pose a significant threat to riverine operations. The primary threats are from contact mines (both moored and drifting) as well as remotely controlled underwater IEDs. While no one methodology can eliminate the threat, several complementary approaches (ISR, clearance, targeting remote controllers, waiting for drifting mines to pass, and in-stride mine avoidance) can reduce its potency.

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Glossary

AAV	amphibious assault vehicle
AIF	anti-Iraqi forces
AO	area of operations
AOR	area of responsibility
ASPB	assault support patrol boat
ASW	anti-submarine warfare
AT/FP	anti-terrorism force protection
ATSB	advance tactical support base
BEB	bridge erector boat
BHO	battle handover
BLT	battalion landing team
BSU	boat support unit
C2	command and control
C3	command, control, and communications
CAS	close air support
CCD	Combatant Craft Department
CENTCOM	U.S. Central Command
CFLCC	Combined Force Land Component Commander
CIC	command information center
CINCEUR	Commander-in-Chief, U.S. European Command
CINCNELM	Commander-in-Chief, US Naval Forces Eastern Atlantic and Mediterranean
CM	consequence management
CMC	Commandant of the Marine Corps
CNA	Center for Naval Analyses
CNO	Chief of Naval Operations
CSNP	causeway section, non-powered
COA	course of action
COCOM	combatant command
COIN	counter insurgency
COLMAR	Colombia Marines
COMNAVFORV	Commander, U.S. Naval Forces Vietnam

COMTRALANT	Commander, U.S. Naval Training Command, Atlantic
CONUS	continental United States
COSRIVDIV	coastal river division
COSRIVRON	coastal river squadron
COST	Combined Operations Seminar Team
CRRC	combat rubber raiding craft
CS	combat support
CSAR	combat search and rescue
CSG	carrier strike group
CSNP	causeway section, non-powered
CSS	combat service support
DoD	Department of Defense
DoN	Department of the Navy
DOTES	doctrine, organization, training & education and supporting establishment
DOTMLPF	doctrine, organization, training, material, leadership and education, personnel, and facilities
DSU	dam security unit
EEZ	economic exclusion zone
EOD	explosive ordnance disposal
ESG	expeditionary strike group
EWTG	Expeditionary Warfare Training Group
FAO	foreign area officer
FID	foreign internal defense
FM	Field Manual
FOC	full operational capability
FSRG	Force Structure Review Group
FW	fixed-wing
GCE	ground combat element
GWOT	global war on terror
HADR	humanitarian assistance/disaster relief
HAL	helicopter attack squadron, light
HC	helicopter cargo
HET	human exploitation team
HLS	Homeland Security
HN	host nation
HSPD	Homeland Security Presidential Directive
HUMINT	human intelligence
HVA	high-value asset

HVT	high-value target
IBU	inshore boat unit
IED	improvised explosive device
ILOCC	in lieu of coordination cell
ILS	integrated logistics system
I MEF	First Marine Expeditionary Force
II MEF	Second Marine Expeditionary Force
IO	information operations
IOC	initial operational capability
ISR	intelligence, surveillance, and reconnaissance
IVO	in view of
JCIDS	joint capabilities integration and development system
JFLCC	Joint Force Land Component Command
JFMCC	Joint Force Maritime Component Command
JFSOCC	Joint Forces Special Operations Command
JPAT	joint planning and assistance team
JROC	Joint Requirements Oversight Committee
KAA	Khowr Adb Allah
LASO	landing attack and subsequent operations
LATAM	Latin America
LCAC	landing craft, air-cushioned
LCM	landing craft, mechanized
LCPL	landing craft personnel (large)
LCU	landing craft, utility
LCVP	landing craft vehicle and personnel
LOC	line of communication
LST	landing ship, tank
LSV	logistics support vessel
LZ	landing zone
MAGTF	Marine air-ground task force
MARFORLANT	Marine Forces Atlantic
MARFORSOUTH	Marine Forces South
MARFPCOM	Maritime Force Protection Command
MARSOC	Marine Special Operations Command
MATC	mini-armor troop carrier
MAU	Marine amphibious unit
MCCDC	Marine Corps Combat Development Command
MCIA	Marine Corps Intelligence Agency

MCM	mine/mining countermeasures, mine countermeasures ship
MCO	major combat operations
MDA	maritime domain awareness
MEF	Marine expeditionary force
METL	mission-essential task list
MEU(SOC)	Marine expeditionary unit, special operations capable
MIO	maritime interception operations
MIUW	mobile inshore undersea warfare
MNS	mission needs statement
MNV	mine neutralization vehicle
MOOTW	military operations other than war
MORE	military operations in a riverine environment
MOS	military occupational skill
MPF	maritime prepositioned force
MPF(F)	maritime prepositioned force (future)
MRF	mobile riverine force
MSB	minesweeping boat
MSM	minesweeper river
MSO	maritime security operations
MTT	mobile training team
NAVSCIATT	Naval Small Craft Instruction and Training Team
NAVSCIATTS	Navy Small Craft Instruction and Technical Training School
NAVSEASYSCOM	Naval Sea Systems Command
NAVSPECWARCOM	naval special warfare command
NAVSPECWARGRU	naval special warfare group
NCW	naval coastal warfare
NCWG	naval coastal warfare group
NCWRON	naval coastal warfare squadron
NECC	Navy Expeditionary Combat Command
NEO	noncombatant evacuation operation
NIOTC	Naval Inshore Operations Training Center
NOSG	Naval Operations Support Group
NSPD	National Security Presidential Directive
NSWG	Naval Special War Group
NWP	naval warfare publication
OCONUS	outside (the) continental United States
OIF	Operation Iraqi Freedom

OMFTS	operational maneuver from the sea
OOTW	operations other than war
ORD	operational requirements document
PBL	patrol boat light
PBR	fiberglass patrol boat
PC	patrol coastal boat
PCF	patrol craft, fast
PG	patrol gunboat
POE	potential operating environment
PSU	port security unit
PSYOPS	psychological operations
PTF	fast patrol craft
QDR	Quadrennial Defense Review
QRF	quick-reaction force
RAC	river assault craft
RAG	river assault group
RCE	riverine combat element
RCT	regimental combat team
RHIB	rigid-hull inflatable boat
RLS	riverine landing site
R&S	reconnaissance and surveillance
ROC	required operational capability
ROE	rules of engagement
ROST	riverine operations seminary team
RPG	rocket-propelled grenade
RTC	Riverine Training Center
RTT	riverine training team
RW	rotary-wing
SA	situational awareness
SAC	scene of action commander
SAR	search and rescue
SBT	special boat team
SBU	special boat unit
SCCo	small craft company
SCIATT	Small Craft Inspection and Training Team
Seabee	naval construction force
SEAL	sea-air-land (team)
SEALORDS	Southeast Asia Lake, Ocean, River, Delta Strategy
SERE	survival, evasion, resistance, & escape
SLWP	side-load warping tug

SMTC	Special Missions Training Center
SOCOM	Southern Command
SOCR	special operations craft riverine
SOF	special operations forces
SOTG	Special Operations Training Group
SPECBOATRON	special boat squadron
SURC	small unit riverine craft
STAB	strike team assault boat
STOM	ship-to-shore operational maneuver
TACMEMO	tactical memorandum
TF	task force
T/O	table of organization
TPSB	transportable port security boat
TSC	theater security cooperations
TTP	tactics, techniques, and procedures
TYCOM	type commander
UAV	unmanned aerial vehicle
UDT	underwater demolition team
UJTL	Universal Joint Task List
UNTL	Universal Naval Task List
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	United States Navy
USNAVSTA	U.S. Naval Station
USOUTHCOM	U.S. Southern Command
USSOCOM	U.S. Special Operations Command
UAV	unmanned air vehicle
UUV	unmanned undersea vehicles
VAL	attack squadron, light
VBSS	visit, board, search, and seizure
WMD	weapons of mass destruction
WPB	patrol boat
WPC	coastal patrol boat

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