

UNDERSEAWARFARE

U. S. S U B M A R I N E S... B E C A U S E S T E A L T H M A T T E R S

International Cooperation

Undersea Efforts Strengthen Overseas Ties



INSIDE

Italian Sub in U.S. Waters

International Submarine Rescue

The Royal Navy's U.S. Submariners

U.S.-Australian Partnership

Christening PCU *California*



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UNDERSEAWARFARE

THE OFFICIAL MAGAZINE OF THE U.S. SUBMARINE FORCE

International Cooperation Undersea Efforts Strengthen Overseas Ties

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Cmdr. Steve Mack, commanding officer of the *Virginia*-class attack submarine USS *Hawaii* (SSN 776), is greeted by the daughter of a Republic of Korea Navy senior chief petty officer during *Hawaii's* arrival in Busan for a scheduled port visit.

Photo by Lt. Jared Apollo Burgamy

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FORCE COMMANDER'S CORNER

"The Submariner is the key to our success. Not just the best boats, sensors and weapons, but all these together, operated by the best Submariners."

Vice Adm. John Richardson, USN,
Commander, Submarine Forces



This edition of UNDERSEA WARFARE focuses on international cooperation—the power and synergy of working with allies and partners. I think that we submariners often lead the way in international engagement. Often, when the U.S. Navy wants to enhance a relationship with another navy, we find that there is already a rich relationship between submarine forces in place that includes waterspace management, submarine rescue, port visits, personnel exchanges and fast friendships between the two forces.

This is completely natural. Submariners worldwide share a common set of circumstances that bind us together. Submarining is dangerous business. It is by no means a natural state to put to sea a steel boat of several thousand tons loaded with weapons and other sources of tremendous potential energy, submerge that boat, propel it for months continuously around the globe, possibly release those weapons to destroy an enemy, and return home safely.

No technology alone can make us safe and effective. It is only possible because of dedicated submariners with deep expertise and a deeper sense of integrity, who feel that they “own” this challenge—it is theirs. We are expected to do the right thing and are truthful about what we say.

Submarining is at its essence a human endeavor.

- We are experts at what we do and masters of our craft.
- Submarine officers and chiefs are engaged combat leaders. Trained supervisors lead and back up expert operators. Learning does not stop when one becomes qualified or more senior—in fact, learning becomes more critical.
- For commanding officers, this takes on special significance. All submariners understand the responsibility, authority and accountability that come with that job. It is the foundation of the special trust that all submariners place in their CO.
- Because of the inherent dangers, submariners have a culture of rigorous use of procedures. But we don't become slaves to a “checklist mentality”; we maintain a questioning, skeptical attitude, ready to adapt to unforeseen events or to take advantage of fleeting opportunities.
- We are committed to making ourselves and our teams better. Successful submarine crews dive in to self-assessment at all levels so that they can constantly improve. The Submarine Force has no equal in the rigor with which we drive errors to zero and maximize warfighting readiness. This is the only way to manage the dangerous undersea environment—turning it from a potential liability into the stealth that allows us to succeed.

A terrific current-day example of international cooperation amongst submariners: As I write this, we are participating in Exercise Bold Monarch 2011 off the coast of Spain. As you'll read in the article on page 6, this exercise is held every three years and is the world's largest submarine rescue exercise, involving submarines, ships and aircraft from both NATO and non-NATO countries, including Russia (this

will be the first time a Russian submarine has participated in *any* NATO exercise). Approximately 2,000 military and non-military personnel will attend from over 20 countries. The exercise is designed to maximize international cooperation in submarine rescue operations—something that has always been very important to NATO and all the submarine-operating nations. With over 40 nations operating submarines worldwide, interest in this exercise extends to the entire global submarine community—including Australia, Brazil, Chile, China, India, Japan, Pakistan, Peru and South Korea—and many nations are sending representatives to observe what is an extremely realistic exercise. Now *that's* partnership!

In summary, in the U.S. Submarine Force, as in all submarine forces, *THE SUBMARINER IS THE KEY TO OUR SUCCESS*. Not just the best boats, sensors and weapons, but all these together, *operated by the best Submariners*. To close my letter, below, I've quoted an excerpt from a terrific book that captures what it meant to be a submariner in Pearl Harbor during World War II. As I read this, it struck me how so much is still the same!

Submariners wearing the dolphins on their lower right sleeve and the sub combat insignia on their left breast seemed to be a breed of sailor apart. Sub sailors were reserved in public and stuck together, reinforcing the image of the “silent” service. They had been where no one else dared.

Chief Petty Officer Joe McGrievy, the Chief of the Boat on *Seahorse* [SS-304], observed, “Submariners kept to themselves. They were reserved because they weren't supposed to talk about their work or themselves. They were indefinitely different. Wearing the dolphins, and especially the combat pin, got you respect. Submariners were volunteers. They had to be, since almost one man in four did not come back.”

Toni Peabody, wife of Harvard-educated submarine officer Endicott “Chub” Peabody, who would become Governor of Massachusetts, thought that submarine officers had a certain something about them, very different, very attractive. You trusted them immediately, she believed. There was plenty of camaraderie among them. They were an exciting bunch to be around, and you liked them almost instinctively.

—from *The Bravest Man—Richard O'Kane and the Amazing Submarine Adventures of the USS Tang*, by William Tuohy

It's a privilege to be a U.S. Navy Submariner and to be in your company!

A handwritten signature in black ink, appearing to read "John Richardson".



DIVISION DIRECTOR'S CORNER

"This will be my final address as Director, Submarine Warfare (N87). During my time here, I have had the privilege to work with an excellent staff of men and women dedicated to ensuring tomorrow's Submarine Force will provide the nation the requisite military capabilities to deter aggression and, when necessary, bring the fight to the enemy."

Rear Adm. Michael Connor, USN,
Director, Submarine Warfare

This will be my final address as Director, Submarine Warfare (N87). During my time here, I have had the privilege to work with an excellent staff of men and women dedicated to ensuring tomorrow's Submarine Force will provide the nation the requisite military capabilities to deter aggression and, when necessary, bring the fight to the enemy. I have full confidence that they will provide Admiral Bruner the same consistently high quality analysis and work as I have enjoyed for the past year.

To this end, the N87 staff has worked hard to develop what we call the "Integrated Undersea Strategy." This strategy is designed to inform undersea warfare planning and investment decisions to ensure that the future Navy:

- 1. Provides the joint forces the right types and numbers of submarine platforms to respond to a changing world.** Nuclear-powered submarines can rapidly deploy to the far-flung regions of the world in a non-provocative, covert posture. Combatant commanders recognize that the inherent stealth of a well designed, built and maintained submarine is highly desired both in peace and war.
- 2. Maintains the necessary undersea payload volume to deliver and service the mission payloads needed by the combatant commanders.** Platforms without the correct air and ocean interfaces, storage volume, and adaptability will constrain the Submarine Force's ability to host future weapons, sensors, and unmanned air or underwater vehicles.
- 3. Develops the range of payloads (sensors and weapons) to fully utilize our Submarine Force's asymmetric advantage—stealth.** As countries develop advanced systems to deny U.S. forces unimpeded use of international waters and airspace, U.S. submarines retain the ability to penetrate anti-access/area-denial (A2AD) at the time and place of our choosing. This capability is wasted without the right mix of weapons and sensors to employ once the submarine is on station.
- 4. Provides the right people with the right skills that can prepare for and execute radically new missions in a reasonable timeframe.** While technology alone cannot master the breadth and complexity of how and why we use submarines, we must continue to advance the state of the force to provide our Submariners, our most valuable and flexible asset, the best possible training and tools for completing ever more challenging missions safely and effectively.

It is imperative that we accomplish the goals above within the Navy's expected fiscal environment. To do so will require applying targeted investments to properly matured technology. We will need to look for evolutionary ideas that can provide revolutionary effects.

Even with proper investments, the Submarine Force, and the Navy, will not be able to accomplish all missions at all times by itself. Combatant commanders already rely on close cooperation with foreign submarine forces for relationship-building and operational support. This trend will continue for the foreseeable future.

Cooperation takes many forms. With some countries, we engage in technical collaboration such as our combat control system and torpedo partnerships with the Royal Australian Navy, described on page 12. For other countries, our cooperation manifests in exercise participation such as the international submarine rescue collaboration described on page 6 or the anti-submarine warfare training with the Italian Submarine (ITS) *Scirò* (S 527) described on page 4. Sometimes cooperation is accomplished on a more personal level through personal exchange programs such as the experiences Lt. Cmdr. Kristof describes on page 8.

Regardless of the manner of cooperation, one common thread can be found again and again—the development of mutual respect and trust through the exchange of cultures and the professionalism demonstrated by all parties involved. It is up to those of us wearing the uniform to continue this thread through every interaction with our foreign counterparts, be it an exchange program or deployed port visit.

Again, I thank the men and women of N87 for their dedication and hard work. Although my current duties and focus shift as I become Director, Naval Warfare Integration Group (N00X), I hope to cross paths with you all again in the fleet!

UNDERSEAWARFARE

The Official Magazine of the U.S. Submarine Force

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UNDERSEA WARFARE is the professional magazine of the undersea warfare community. Its purpose is to educate its readers on undersea warfare missions and programs, with a particular focus on U.S. submarines. This journal will also draw upon the Submarine Force's rich historical legacy to instill a sense of pride and professionalism among community members and to enhance reader awareness of the increasing relevance of undersea warfare for our nation's defense.

The opinions and assertions herein are the personal views of the authors and do not necessarily reflect the official views of the U.S. Government, the Department of Defense, or the Department of the Navy.

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LETTERS TO THE EDITOR

In keeping with **UNDERSEA WARFARE** Magazine's charter as the Official Magazine of the U.S. Submarine Force, we welcome letters to the editor, questions relating to articles that have appeared in previous issues, and insights and "lessons learned" from the fleet. **UNDERSEA WARFARE** Magazine reserves the right to edit submissions for length, clarity, and accuracy. All submissions become the property of **UNDERSEA WARFARE** Magazine and may be published in all media. Please include pertinent contact information with submissions.

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FROM THE EDITOR,

UNDERSEA WARFARE has long been available on the OPNAV website of the Director of Submarine Warfare (N87). Readers of the Submarine Force's official magazine, particularly younger readers, will be pleased to know that we are now on Facebook and Twitter as well!

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at <http://www.facebook.com/USWMagazine>

Follow us on Twitter



at <http://twitter.com/USWMagazine>

We invite you to interact with us on either of these platforms.

Olivia Logan
Managing Editor,
UNDERSEA WARFARE Magazine

SAILORS FIRST



Petty Officer 2nd Class Darrius Jenkins, assigned to the pre-commissioning unit of the *Virginia*-class attack submarine *Mississippi* (SSN 782), speaks with children at Central Mississippi Boys and Girls Club during Mississippi Navy Week, one of 21 Navy Weeks planned across America for 2011.

Photo by Senior Chief Petty Officer Gary Ward

In the Footsteps of Verrazano

Visiting the U.S. East Coast in ITS *Scirè*

In 1524, the Italian navigator Giovanni da Verrazano became the first European to explore and report on the East Coast of what is now the United States. From Aug. 27 to Nov. 3, 2009, the Italian Submarine (ITS) *Scirè* (S 527) carried out CON.US 09 (Continental United States 2009), a two-and-a-half month deployment to the U.S. East Coast that included participation in the 2009 Joint Task Force Exercise (JTFEX 09) as well as several other exercises involving U.S. Navy submarines and anti-submarine warfare (ASW) assets. I had the good fortune to serve on *Scirè* during this interesting and valuable deployment.

ITS *Scirè* was laid down at the Muggiano yard of the Italian shipbuilder Fincantieri in July 2000, launched on Dec. 18, 2004, and commissioned in February 2007. She takes her name from a 600-ton Italian submarine of World War II that was specifically designed to support special forces. The most famous of this boat's wartime operations took place on Dec. 19, 1941, when she maneuvered close to the Egyptian port of Alexandria and released a team of six special operators, led by Lt. Luigi Durand de la Penne, who planted charges that sank the British battleships HMS *Valiant* and HMS *Queen Elizabeth* in shallow water as well as damaging the tanker *Sagona* and the destroyer HMS *Jervis*.

Today's *Scirè* and her sister ship, *Salvatore Todaro* (S 526), commissioned in 2006, form the new backbone of the Italian submarine force, which will be enhanced by the commissioning of two further units between 2015 and 2016. These Type U212A submarines are the result of a joint Italian-German program to produce a new generation of non-nuclear



Scirè carries out a hoist exercise with an SH-60 of the Helicopter Maritime Strike Weapons School, U.S. Atlantic Fleet, off Mayport, Fla.

submarines combining conventional diesel-electric propulsion with air-independent propulsion (AIP) for silent cruising.

When operating on AIP, *Scirè* is extremely silent, requiring no noisy snorkeling to recharge the battery. Fuel cells—electrochemical conversion devices based on polymer electrolyte membrane (PEM) technology—combine hydrogen and oxygen stored in the submarine to produce water, heat and the electricity that powers the propulsion engine and the other shipboard systems.

Other key features of the *Salvatore Todaro* class are:

- An “X-shaped” arrangement of the stern planes that facilitates maneuvering
- A prismatic hull cross-section and smoothly faired transitions from the hull to the sail that enhance stealth
- Extensive use of non-magnetic materials in the hull and internal fixtures to minimize the magnetic signature
- Reduced infrared and radar signature
- A fully digitalized combat management system (CMS) and a highly advanced sonar
- Silent Type A-184 Mod 3 torpedoes, built by the Italian company WASS, and a weapon subsystem that allows full interoperability with NATO-standard torpedoes

Scirè left Taranto, her home base in southern Italy, on July 20 and reached Naval Submarine Base New London, in Groton, Conn., on Aug. 27. After a short call, she set sail for Naval Station Mayport, Fla., on the 30th. Arriving on Sept. 8, she promptly commenced an intensive training program

that included involvement in JTFEX 09 from Sept. 14 to Sept. 21.

Scirè conducted at-sea anti-submarine warfare exercises and tactical development exercises against U.S. naval assets, including P-3C and SH-60 aircraft, SSNs, and the USS *Eisenhower* Carrier Battle Group. Several vertical replenishment (VERTREP) operations provided valuable opportunities to check and improve interoperability with U.S. Navy helicopters. *Scirè* and U.S. submarines also exchanged sea riders to maximize the exchange of knowledge and experience.

After completing this intensive training, *Scirè* returned to Groton for a few days to refuel. She departed Groton on Nov. 3 and reached Taranto on Dec. 20, having been away from Italy on various missions for a total of five months.

CON.US 09 was actually the second deployment of an Italian submarine to the American East Coast for intensive ASW training with the U.S. Navy. The first deployment, CON.US 08, took place the year before, when *Salvatore Todaro* became the first Italian submarine to cross the Atlantic since the end of World War II.

More visits are likely. In 2009, the two navies launched the Italian-U.S. ASW Initiative, whose mission is to increase mutual knowledge of ASW doctrine and training and enhance the interoperability and readiness of U.S. and Italian submarine and anti-submarine assets, thereby improving the ability to cope with rising submarine threats around the world. Within this same framework, U.S. assets take part in combined or bilateral exercises in the Mediterranean arranged by the Italian Navy,



Italian Navy photo

Vice Adm. Paolo La Rosa, then-Chief of the Italian Navy General Staff (a position roughly equivalent to the U.S. Navy's Chief of Naval Operations) visits *Scirè's* crew at Naval Station Mayport, Fla.

such as *Mare Aperto*, whose 2009 edition benefitted from the participation of U.S. submarines.

CON.US 09 was an invaluable experience for the Italian submarine community and particularly for *Scirè's* crew, who gained experience and skills by prolonged interaction and integration with the U.S. Navy and its world-class submarine component. We profited not only from lessons learned at sea but also from planning, coordination and data analysis conducted ashore. Indeed, CON.US 09 offered several other useful experiences, such as the Atlantic crossings, which entailed three weeks of underwater navigation and required us to deal with environmental factors never experienced in the Mediterranean, such as:

- The Gulf Stream, whose profile had to be considered in assessing the environmental context for operations
- Hurricane Bill, which required us to plot and track the storm's course and plan the sub's movements to minimize its impact on the mission

Another important gain from CON.US 09 was our interaction with the crew members of U.S. submarines. We received an extremely warm and friendly welcome from American submariners during port calls at Groton at the beginning and end of our stay in North American waters. Our host ship, USS *Toledo*, (SSN 769), did everything possible to support us and meet all our needs, including arranging barbecues and other events at the officer and petty officer clubs during the weekends. These occasions provided an informal, friendly

setting to become better acquainted and share experiences, with both sides asking and answering lots of questions about quality of life on board, career paths, training criteria, years spent on board, etc.

American submariners visiting *Scirè* were impressed by the small size of her crew and the spaciousness of her interior for a boat that is only 60 meters long. Highly automated controls and computerized procedures have reduced the crew of *Todaro*-class boats to no more than 30 people, including the very few people required to man all stations in the combat information center when underway. Additionally, crew members are rotated to maintain a high level of operational readiness, especially during long deployments, and a deployable support group (SUG) of about 15 people follows the submarines to the ports they visit to take care of technical and logistic matters. The SUG is composed of experienced officers and petty officers, all former submariners, belonging to the Technical and Logistic Department of the Italian Navy's Submarine Force Command (COMFORSUB).

Scirè's host during her three visits to Naval Station Mayport in September and October 2009 was the U.S. Navy's "surface community." Our Mayport sister ship, USS *Underwood* (FFG-36), performed that role outstandingly. Like *Toledo*, she offered a warm welcome, took care of all *Scirè's* needs, and arranged unforgettable events that made the Italian crew feel at home. The nearness of Naval Submarine Base King's Bay, Ga., also made it possible to arrange a "cross deck" between *Scirè* and USS *Wyoming* (SSBN 742). After receiving some *Wyoming* repre-



Italian Navy photo

Cmdr. Diego Hernández, commanding officer of USS *Wyoming*, extends a warm welcome to *Scirè's* commanding officer, Lt. Cmdr. Alberto Tarabotto.

sentatives on board *Scirè*, a group of Italian submariners went to King's Bay to visit the boomer and the Trident Training Facility. The experience gave both the Italians and Americans the chance to observe operational, technical and logistic environments different from their own.

Finally, in the spirit of the submariner brotherhood, one of *Scirè's* officers attended the 46th Submariners' Congress, held in San Diego, Calif., Sept. 8-12, by the International Submariners' Association—United States of America (ISA-USA) in conjunction with the United States Submarine Veterans (USSV).

CON.US 09 was an invaluable opportunity to improve interoperability between the U.S. and Italian navies, perfectly conducted within the framework of the "ASW Initiative." We gained a great deal of experience and tactical know-how operating against SSNs in several exercises, especially experience in employing the low-frequency towed-array sonar only recently embarked on *Todaro*-class submarines. At the same time, CON.US 09 allowed us to demonstrate the remarkable flexibility of the latest class of Italian submarines, including becoming the first non-nuclear submarine to effectively support a carrier battle group.

We very much appreciated the opportunity to interact on many levels with the world's most prepared and best equipped Submarine Force and also to display with pride the features of Italy's most modern submarines. The bottom line of CON.US 09 was that despite differences of assets and tactics, everyone experienced the strong feelings of friendship and brotherhood that binds together submariners of many nationalities all around the world.

Lt. Rossitto was executive officer of ITS *Scirè* during CON.US 09.



Photo by Petty Officer 3rd Class Spencer Mickler

Submarine Rescue Spans the Globe

At least 44 countries operate more than 400 submarines worldwide. The sophisticated safety measures in modern submarines and rigorous crew training reduce the risk of a serious mishap to an extremely low level, but nothing can reduce it to zero. Every submarine runs some small risk of a disabling casualty due to collision, flooding, equipment failure, etc.

If a disabled sub has an escape trunk and bottoms in less than 600 feet of water, the surviving crew can, at least theoretically, escape to the surface without outside rescue. But even at depths of less than 600 feet, it is preferable to rescue the surviving crew of a bottomed submarine if possible. All submariners are therefore interested in a robust rescue capability.

The United States fielded the world's first submarine rescue system in the early 1930s. The Submarine Rescue Chamber (SRC), essentially a diving bell with special hatches and a downhaul system for mating with a submarine, could rescue personnel from submarines in "shallow water" down to about 850 feet. The SRC proved its worth in 1939 by bringing up 33 survivors in four sorties to USS *Squalus* (SS 192), which had sunk off the New Hampshire coast. The Navy's current SRC differs little from the original one.

In 1963, USS *Thresher* (SSN 593) sank off New Hampshire in much deeper water with the loss of all hands. Although she passed crush depth long before reaching bottom, her loss highlighted the requirement for a deep-diving rescue system to close the gap between

the shallow reach of the SRC and the depth at which a modern submarine could survive. For timely rescue in distant waters, the new system had to be transportable by air. The highly maneuverable Deep Submergence Rescue Vehicle (DSRV) developed to meet these requirements could be flown to a friendly seaport in the vicinity of an accident and loaded aboard a surface support ship or one of several nuclear submarines specially modified to serve as "mother submarines" (MOSUBs).

The DSRV's global reach opened up unprecedented opportunities for international cooperation. In an early step toward interoperability, Britain and France also modified some submarines to serve as DSRV MOSUBs. In 1986, the North Atlantic Treaty Organization (NATO) sponsored the first "Exercise Sorbet Royal," a multinational exercise focused on ensuring a practical capability to cooperate in all aspects of submarine rescue. The United States entered into agreements with other countries to provide rescue services in the event of a submarine accident. Under these agreements, the U.S. Navy began to conduct inspections to ensure that other navies' submarines were capable of DSRV and SRC rescue. The Navy also began to survey airports, roads and seaports to document the most efficient path for delivering a rescue vehicle and thus minimize the time-to-first-rescue (TTFR).

NATO established the Submarine Escape and Rescue Working Group (SMERWG) as a forum for working out issues such as making equipment interoperable and

establishing common doctrine. Like the Sorbet Royal exercises, the SMERWG was open not just to NATO member nations, but to any country invited by NATO or a NATO member. In 2001, another grouping, the Asia-Pacific Submarine Conference (APSC), began to meet annually to discuss submarine operations in the Pacific and Indian Ocean regions. APSC discussions defaulted to submarine escape and rescue when few other topics could be identified that all participants would talk about.

The August 2000 loss of the Russian submarine *Kursk* provided fresh impetus for multinational coordination and collaboration in submarine rescue. In 2003, NATO established the International Submarine Escape and Rescue Liaison Office (ISMERLO) to operate under the SMERWG's authority as a clearing house for escape and rescue information, including facilitating rescue efforts. Hosted by Allied Submarine Command in Norfolk, Va., and staffed by experts from the U.S. and other NATO countries—as well as two billets for non-NATO nations—ISMERLO's main focus is a collaborative website where participating countries can share information about rescue capabilities and activities, discuss new initiatives, and quickly facilitate a multinational rescue in the event of a submarine sinking.

In 2008, the U.S. Navy replaced the aging DSRVs with the Submarine Rescue Diving and Recompression System (SRDRS). Whereas the DSRVs had had to wait for one of the few MOSUBs to reach the general

vicinity of a submarine casualty, the SRDRS could operate from any vessel of opportunity (VOO), i.e., any naval auxiliary or commercial offshore support vessel with the deck space and strength to support the SRDRS equipment. Most regions of the world have ships that can serve as VOOs.

The SRDRS consists of three elements. The first is the Atmospheric Dive System 2000 (ADS 2000), a manned, one-atmosphere dive suit for inspecting a bottomed submarine and clearing escape hatches down to 2,000 feet. The second is the Pressurized Rescue Module (PRM)—named *Falcon*—a tethered, remotely operated rescue vehicle launched and piloted from the deck of a VOO. The PRM can rescue 16 sailors per trip down to 2,000 feet. The third element, scheduled to become operational in 2014, is a transfer-under-pressure (TUP) capability consisting of a deck transfer lock (DTL) that can mate with the PRM, receive Sailors exposed to high pressure, and transfer them to a decompression chamber without exposing them to normal atmospheric pressure.

The Navy team that keeps U.S. submarine rescue systems on call around the clock is the San Diego-based Deep Submergence Unit (DSU), which includes not only active-duty personnel, but also reservists, contractors and government civilians. In fact, more than half the DSU staff are reservists. The Submarine Escape and Rescue Review Group (SERRG), which supports the DSU, is chaired by Commodore, Submarine Development Squadron Five, and includes representatives from the DSU, the Atlantic and Pacific submarine commands, OPNAV, the Naval Sea Systems Command, ISMERLO, the Naval Submarine School and the Naval Medical Submarine Research Lab.

Like the DSRV before it, the SRDRS serves as the focal point for submarine rescue agreements with partner countries, which provide dedicated rescue ships or VOOs, transportation from qualified airports and seaports, or other support the participants deem appropriate. More than 20 such agreements are now in effect or under discussion. The goal is to load submarine rescue assets aboard aircraft at Naval Air Station North Island in San Diego, transport them to the location of a distressed submarine, and make them ready for rescue—all within 72 hours of notification.

The U.S. routinely participates in exercises designed to sharpen skills and accustom participants to working with personnel of

other nationalities. The largest is the NATO-sponsored Exercise Bold Monarch, formerly called Sorbet Royal, which takes place every three years. In the words of NATO's invitation to prospective 2011 participants, Bold Monarch demonstrates "that NATO, in participation with submarine operating nations, can cooperate in lifesaving operations from a distressed submarine, including all medical aspects involved."

Ships, submarines and rescue systems from 14 nations took part in Bold Monarch 2008, while 26 countries sent observers. Submarines from the Netherlands, Norway, and Poland worked with rescue systems provided by three other countries. The U.S. rescue system was airlifted into the theater, providing considerable practice in the associated logistics. The U.S. PRM *Falcon* "rescued" over 200 personnel in 13 sorties to bottomed submarines. Most of the 29 flag-level dignitaries who visited the exercise got to experience being "rescued," including a French three-star rescued by a Russian system from a Norwegian sub.

The corresponding Pacific region exercise is called Pacific Reach, the regular participants being Australia, Japan, Singapore, South Korea and the United States. Singapore, which hosted the first Pacific Reach in 2000, also hosted the most recent one in August 2010. Thirteen countries sent observers in 2010, among them China, India, Indonesia, Malaysia, Pakistan, South Africa, Thailand, and Vietnam. Japanese, Singaporean, and Korean submarines worked with rescue systems from the U.S. and Singapore. The United States and Singapore also provided, respectively, the rescue and salvage ships USNS *Safeguard* (T-ARS 50) and MV *Swift Rescue*.

Many submarine-operating countries also conduct bilateral rescue exercises, one example being the U.S.-Chilean exercise called CHILEMAR. CHILEMAR was the brainchild of the commander of the DSU and the skipper of the Chilean submarine *CS Simpson*, who met while both were attending Chile's Naval War College. The first exercise took place in September 2008. In October 2010, *CS Thomson* participated in a second CHILEMAR off San Diego.

Time has always been the most critical factor in submarine rescue, and only a multinational effort can provide timely rescue in distant waters. It requires common technical standards, common doctrine, and close communication, as well as frequent multi-

lateral and bilateral exercises, to build proficiency, mutual understanding, and trust. The SMERWG and the APSC provide the framework for common efforts. ISMERLO provides the communication medium and facilitators for rapid and effective collaboration. Bold Monarch, Pacific Reach and a host of smaller exercises provide the opportunities for honing cooperative rescue capabilities.

The U.S. Navy's small but highly professional submarine escape and rescue community, relying heavily on expertise from the reserve component, plays a central role in all of these activities, working with their counterparts around the world to provide prompt rescue for submariners trapped in the unforbearing depths.

Capt. Osen is the chief staff officer of the U.S. Navy's submarine rescue reserve component.

(Opposite) Lt. Rafael Castillo, left, Lt. Cristian Ahumada, and Lt. Patricio Puyol, of the Chilean submarine *CS Thomson* (SS 20), inspect the submarine rescue chamber as the chamber dives approximately 450 feet to *Thomson* during exercise CHILEMAR II. (Below) Navy Diver 2nd Class Shane Olson goes through pre-diving inspections in the Atmospheric Diving Suit 2000 aboard the Military Sealift Command fleet ocean tug USNS *Sioux* (T-ATF 171) before a 500-foot dive.



Photo by Petty Officer 3rd Class Spencer Mickler

Joining Britain's Royal Navy

via the

Personnel Exchange Program

Perhaps you have seen officers from foreign navies serving in billets in our Navy, or even in our submarine community. For example, Lt. Cmdr. Justin Codd, Royal Navy (RN), served on the staff of Commander, Task Force 69 (CTF-69), in Naples, Italy. Lt. Cmdr. John Aitken, RN, served on the staff of Commander, Submarine Development Squadron TWELVE (COMSUBDEVRON TWELVE), in Groton, Conn.; and Lt. Cmdr. James McGuire, RN, worked in Operations (N3) on the staff of Commander, Submarine Forces. However, you may not know that American submarine officers also serve in foreign navies under the Personnel Exchange Program (PEP), through which the U.S. Navy “loans” officers and sailors to other countries. I and three other submarine officers—Lt. Cmdrs. Jim Boerner, Don Galyon, and Drew Preston—

served together in PEP billets in the U.K. Others have served in Canada and Australia.

The Anglo-American “special relationship” is nowhere more evident than in the U.S. and

U.K. submarine forces, which closely share intelligence, technology, and tactical best practices; send students to each others’ command courses (see *A N.Y. Yankee in Queen Elizabeth’s Navy, UNDERSEA WARFARE*, Summer 2008); exercise with each other regularly; and plan and conduct operations bilaterally. Both submarine forces operate, manage their people and assets, and generally conduct business in fairly similar ways. However, there are enough differences that exchange officers can be very helpful for “greasing the skids” of cooperative efforts, as well as for learning about the other submarine force’s best practices, which might later help improve their own force.

The Personnel Exchange Program

The Personnel Exchange Program (PEP) originated during the Cold War to sustain and enhance cooperative maritime relations and interoperability with U.S. allies and partners. Originally limited to our closest English-speaking allies, it now includes 18 nations as diverse as Belgium, Brazil, Chile, Germany, Japan, and Korea. Of more than 100 PEP officer billets, 15 are open to submariners. Eight are specifically designated for unrestricted line officers qualified in submarines (1120s)—four in the U.K., three in Canada, and one in Australia. (See *The U.S. Navy and Royal Australian Navy Relationship: A Partnership*

to Educate, UNDERSEA WARFARE, Summer 2007.)

In an April 2008 PERSONAL FOR message to flag officers, commanders and senior executives, then Chief of Naval Personnel Adm. John C. Harvey, Jr. noted that “PEP has contributed markedly to the stability and depth of [our] naval alliances. The effectiveness of our global maritime partnerships also depends heavily on our development of collaborative relationships with new friends in increasingly critical geostrategic areas.” Predicting that the number of participating nations would grow to as many as 40 in the coming years, he urged the U.S. Navy to “change the perception that

[a PEP tour] is a disassociated, or worse yet, unvalued tour of duty. PEP should be viewed and rewarded as a preferred career milestone [and] valued as an instrument of the Maritime Strategy, employed and designed to achieve an enduring effect.”

Unfortunately, the perception that Adm. Harvey spoke of continues. Many still regard a PEP tour as a paid vacation of sorts. It is certainly pleasant—and educational—to spend leave time traveling through Europe, but we get no more leave than anyone else, and our billets carry significant responsibility and require the same dedication as any Submarine Force job. U.S. Navy submarine PEP officers contribute to the Royal Navy in

real and meaningful ways, serving in diverse roles, including work that, for example, affects current and future British submarine capabilities, helps to address key interoperability issues, or even involves going to sea with U.K. forces. In the process, we learn important skills and learn valuable lessons from which both navies can benefit.

Where We Serve and What We Do

Our four billets in the U.K. demonstrate the wide range of duties available to U.S. submarine officers. All were challenging and extremely rewarding. Not one of them was a 'figurehead' or liaison role, created solely to ease bilateral communication. Each involved integral RN business, as the following descriptions demonstrate. I am certain that the PEP billets in Canada and Australia are similar.

The Maritime Warfare Center (MWC), located at HMS *Collingwood*, in Fareham, Hampshire (many RN shore facilities have ship names), is the focal point for RN doctrine and tactical development. Its mission is to "provide the focus for operational knowledge exploitation (OKX)—the requirement to observe and process front-line operational experiences as quickly as possible so as to improve our fighting power." It is a "one-stop-shop" for the evolution and dissemination of maritime doctrine in a joint environment through tactical development, operational analysis, doctrine development, education and war gaming, and the development of operational-level war fighting, planning and decision-making."

Lt. Cmdr. Boerner served in MWC's Underwater Warfare (UWW) Division, which is analogous to and works very closely with COMSUBDEVRON TWELVE. His primary responsibility was as a "reachout" officer for four *Trafalgar*-class SSNs, consolidating best practices and lessons identified into timely tactical guidance in the form of TACNOTES, similar to the SUBDEVRON TWELVE Newsletter. His other tasks varied with the needs of the fleet, ranging from coordinating with the U.S. Arctic Submarine Laboratory for U.K. participation in ICEXs to

developing and conducting tactical trials for new equipment. He deployed aboard HMS *Ark Royal* during the July 2010 "AURIGA" deployment to the U.S. East Coast, serving as the MWC's forward presence to support the *Ark Royal* Carrier Strike Group in assessing and improving ASW tactics and coordinating tactical development trials.

The U.K. Maritime Battle Staff (COMUKMARFOR), at HMS *Excellent*, in Portsmouth, Hampshire, is a scalable operational command whose primary role is to command U.K., allied or coalition forces worldwide. Staffed by officers of the British services (mostly RN) as well as naval officers from most Western European nations, it has the expertise and manpower to deploy as a Maritime Component Commander overseeing several naval task groups in a campaign. When not deployed, it develops maritime capability and coordinates operations through fleet, joint, and allied exercises.

Lt. Cmdr. Drew Preston (left) with other officers from COMUKMARFOR during their deployment to Iraq in early 2008.



Photo courtesy of Lt. Cmdr. Nick Kristof

The Maritime Battle Staff has subject matter experts (SMEs) in various fields to support RN exercises, operations, acquisition, training, and doctrine development. Lt. Cmdr. Preston was the future operations submarine planner and targeteer. He served as a member of the Submarine Element Coordinator/Submarine Advisory Team (SECSAT) supporting task group operations, assisted with antisubmarine warfare (ASW) aspects of campaign planning, participated in Tomahawk Land-Attack Missile (TLAM) planning exercises and operations as a launch-area coordinator (LAC), and supported targeting operations. In early 2008, he deployed to the Middle East for four months as a member of COMUKMARFOR.

Navy Command Headquarters (NCHQ) is also located at HMS *Excellent*, in Portsmouth. Lt. Cmdr. Galyon was NCHQ's fleet capabilities submarine TLAM officer, the only staff job dedicated to a single specific weapon system. As the submarine TLAM SME, he worked with various Ministry of Defence (MOD) and Department of Defense (DoD) organizations to maintain and develop RN attack submarines' TLAM capabilities. He was the focal point for TLAM capability, doctrine, policy, and training and was specifically tasked "to maintain connectivity to U.S. TLAM organizations to maintain a relevant knowledge base in order to effect informed decisions and recommendations to his U.K. chain of command." He dealt with doctrine from the tactical to the strategic level, with training, and with cooperation between the U.S. and U.K. acquisition communities.

Lt. Cmdr. Galyon was integrally involved in Britain's taking delivery of the Block IV Tomahawk, and his support of key equipment installs in RN submarines directly improved interoperability with the U.S. He was also involved in initiatives with the RN Submarine School; Flag Officer Sea Training (FOST); and the U.K. Cruise Missile Support Activity (CMSA) to improve and standardize TLAM training both ashore and at sea. In addition to TLAM, he also helped support SSN force generation, capability and readiness.

Commander, Task Force 311 (CTF-311), located in Northwood, Middlesex, is the Royal Navy's sole submarine operating authority (SUBOPAETH), unlike the U.S. Navy, which has several SUBOPAETHs around the world. CTF-311 maintains operational control of all of Britain's less numerous attack submarines, wherever they may be.

I served as CTF-311's deputy SSN operations officer (DSSN), overseeing the day-to-day running of a watchstanding organization made up of a duty submarine controller (a lieutenant or lieutenant commander who is the equivalent to our submarine watch officers) and his two assistants. I was delegated the authority to review and approve all training events in which RN SSNs par-

ticipated. I was actively involved in the writing and review process for all memoranda of understanding (MOUs) and operations orders (OPORDERS) for which the U.K. is a signatory (including, but not limited to, those with the U.S.).

I represented the U.K. in international staff talks with France and other NATO nations. As one of only five lieutenant commanders on the CTF-311 staff, I was given the opportunity to qualify as a command duty officer (CDO). For 18 months, I stood duty as CDO in week-long increments, with full responsibility for all boats at sea and the first person notified when any issue arose. I was the CDO during covert operations, during theatre anti-submarine warfare (TASW) operations, and with U.K. boats deployed from the East Coast of the U.S. to the Far East. I also assisted with exercise planning, and I served as the lead submarine planner for PIT STOP 2010, an international TASW exercise involving U.S., U.K., and French assets.

The Value of PEP

Comments by the British commanding officers of the crop of PEP officers I served with illustrate the benefits of the program for the specific organizations they serve in as well as for the Royal Navy and U.S. Navy in general. “The PEP programme is first rate,” said Cmdr. Donald Walker, RN, the Maritime Battlestaff’s deputy chief of staff. “The individuals we receive are invariably high-class and exceptionally well motivated. They bring with them a fresh perspective, infectious enthusiasm and a thirst for knowledge that causes us all to dig deep into our subjects and challenge the way we do business.”

“The Personnel Exchange Programme benefits all nations on a number of levels,” added Cmdr. Paul Dunn, who heads MWC’s Underwater Warfare Division. “From an MWC perspective, it provides valuable insight into the work of partner nations and links to information that would otherwise probably have been missed. The addition of exchange officers gives greater depth to UWW and offers a different and fresh outlook to a number of issues.” Cmdr. Ian Pickles, at Navy Command, noted the benefits of an outside perspective: “Having an external view helps us to benchmark our own achievements and progress. Where our nations are working together on programmes of mutual interest, the exchange officer can

“Our submarine fleets both deliver an outstanding product; our aims are very similar, but there is no doubt that we approach the problem from, sometimes, very different directions... Having the PEP on the staff can help both nations to understand and help each other.”

Cmdr. Ian Pickles, RN

often quickly identify the correct point of contact, cutting out nugatory staff work by quickly directing effort to where it is required.”

Cmdr. Pickles observed that his department “would certainly not function as well without the unique knowledge, experience and skills of the PEP.” Cmdr. Dunn pointed out that without the PEP, the UWW Division “would lose experience in a number of areas, most notably TG [task group] Ops, TLAM and under-ice operations, where the U.S. has a wealth of operational experience.” Cmdr. Mark ‘H’ Honnoraty, CTF-331’s submarine operations officer, emphasized the integral nature of the PEP officer’s duties. “Submarine Operations requires five lieutenant commanders able to operate; they must act independently, with little supervision, and at a high level. ...As the RN is currently manpower-limited at that level, the loss of the American in that billet, with his understanding and foresight of the U.S. approach to bilateral TASW operations, could prove problematic.”

PEP certainly enhances maritime relations among allies. “Our submarine Fleets both deliver an outstanding product; our aims are very similar, but there is no doubt that we approach the problem from sometimes very different directions,” said Cmdr. Pickles. “Having the PEP on the staff can help both nations to understand and help each other,” Cmdr. Dunn agreed. “The linkages provided through the SUBDEVRON TWELVE–MWC exchange have provided feedback and exchange of information in a number of key areas.” Cmdr. Honnoraty stressed “ability to liaise with the multitude of Americans with whom we interact. We’ve found that sometimes Americans prefer speaking to someone with a familiar

accent when discussing sensitive or possibly controversial topics.”

American submariners familiar with the U.K. PEP also regard it as a ‘win-win’ for both countries. Capt. Jeffrey Trussler, who, as CTF-69, probably had more frequent opportunities to observe the U.K. PEP officers in action than any other senior U.S. submariner, commented: “I am not sure if the U.K. PEP officer on my staff and Commander Kristof’s PEP billet are counterparts in the administration of the program. In daily business, they most certainly are. The U.K. PEP officer on my staff is a post-XO lieutenant commander. Neither of these two positions is window dressing; they both have significant roles on each other’s staffs, and both represent their staffs to our own chains of command and to other countries. I thoroughly enjoyed meetings where Commander Codd was representing CTF-69 and Commander Kristof was representing CTF-311. The confusion of most others in the room was always amusing!”

“I have a feeling in the U.S. that we don’t use the U.K. and other PEP officers to their full potential,” he added. “In the U.K., our officers have to immediately ruck up and produce. I have dealt with several other of our PEP officers; they have real responsibility and great reputations in the U.K. As a previous detailee, I wasn’t much of a fan of the program and clearly didn’t understand it. As an end user now, I have a completely different perspective.”

Of course, American naval officers are not in every way a perfect match for the RN. Speaking of my own limitations, Cmdr. Honnoraty comments that I have “none worth commenting on, aside from his inabil-



Photo courtesy of Lt. Cmdr. Nick Kristof

Lt. Cmdr. Don Galyon enjoying some of the UK's scenic wonders on a trip with the Brits that he worked with.

ity to spell properly in accordance with the English language. He tends to write in 'American' and that can occasionally be a stumbling block." Cmdr. Walker lists as some of Lt. Cmdr. Preston's shortfalls, "A failure to understand the intricacies and niceties of cricket, and a tendency to fall over quickly when not drinking weak American beers." Setting aside the British sense of humor, there is a period of adjustment when transitioning from the U.S. Navy to the Royal Navy, but the adjustments are minor and easily made by any submariner, as we are all required to 'find our footing' and immediately contribute upon arriving at a new command.

Our PEP Experiences

Each of us considered PEP our best tour yet. Lt. Cmdr. Galyon summed up our feelings: "Being in the Navy since 1985, I had never had the opportunity to 'see the world' as the recruiting slogan promised. When given this opportunity, I jumped at the chance. Serving with one of the oldest and most respected navies in the world, and working at Portsmouth, the home of the Royal Navy, were added benefits. Although the RN Submarine Force is smaller than ours, the jobs and missions they conduct are no different than those that we conduct. And, in many cases, the workload is shared or conducted together."

The range of professional experiences can be astounding. "In three years I conducted military operations and training in Pakistan, Turkey, Norway, Germany, Italy, Iraq, France, and the United States. One day, I found myself departing a Dutch ship, traveling on a British landing craft, in Greek territorial waters, on a Turkish Exercise, with Scottish Marines, headed to an American ship. It doesn't get any more interesting than that," said Lt. Cmdr. Preston. "Within six months on the staff, I was conducting a highly challenging job of consequence-management on the Iraqi oil terminals in the northern Arabian Gulf as the expert on oil spill management. Six months later, I was the U.K.'s lead planner for a large multinational joint exercise in a highly disputed region of the Aegean Sea. Subsequently, I became the lead targeteer for the Royal Navy and returned to my warfare roots as their undersea warfare and submarine planning expert. The friends I made and the experiences I gathered are phenomenal."

For me, personally, the tour was professionally outstanding. My CO, Capt. Paul Abraham, told me at my check-in interview: "I don't care about your accent or the color of your uniform; for the next three years you are a member of the RN, and you will be treated as such." He was talking not just about privileges and access, but, more importantly, about my responsibilities and

the demands the Royal Navy placed upon me. It was humbling and a bit scary when I was later given the chance to qualify as a U.K. SUBOPAETH CDO, an opportunity not offered to previous exchange officers in CTF-311, despite my technically not meeting the prerequisites. (Unlike all other CDOs, I was neither a "served executive officer" nor a graduate of the Submarine Command Course.) I will always be proud of the trust the RN submarine community, including its two-star admiral, placed in me and proud that my RN superiors were pleased with my performance.

A Great Opportunity

PEP is important to our maritime strategy, enhancing cooperation with our allies and giving us deeper insight into their capabilities and operations. It is also an amazing opportunity for anyone interested in the challenge of total immersion in the culture of another Navy. All four of us benefitted both professionally and personally from becoming members of the Royal Navy, and it gave us unique perspectives on the challenges our own Submarine Force will face in coming years. We thoroughly enjoyed our time in PEP, and we wholeheartedly recommend it to others.

Lt. Cmdr. Kristof completed his PEP tour in the Royal Navy in July 2010.

Continuing Our Undersea Partnership with the Royal Australian Navy

Today's complex security environment places a premium on international partnerships and operations. The U.S. and Australian submarine forces are contributing to these combined efforts, not only in the manner in which they operate, but also through their unified approach to the development and fielding of shared undersea systems and assets. To that end, both navies operate the highly capable AN/BYG-1 Tactical and Weapons Control System, which enables a submarine to track, monitor and prosecute undersea and surface targets, and the MK48 Mod 7 Advanced Capability (ADCAP) Common Broadband Advanced Sonar System (CBASS) Heavyweight Torpedo. The AN/BYG-1 and the MK48 ADCAP CBASS are unique among submarine systems in being jointly developed under a memorandum of understanding (MOU) between the two governments.

"The MOU provides the framework for the United States Navy and Royal Australian Navy to continue our joint efforts in developing and acquiring the most advanced submarine combat and weapons control system and the best torpedo in the world," said Rear Adm. William Hilarides, who is the U.S. Navy's Program Executive Officer for Submarines.

The U.S. Department of Defense (DoD) and the Commonwealth of Australia DoD signed a ten-year MOU for the cooperative development of the MK48 ADCAP CBASS Torpedo on March 31, 2003, and a five-year MOU for the cooperative development of the AN/BYG-1 on Nov. 5, 2004. These MOUs allowed for the cooperative develop-

ment, production, and support of the two vital submarine systems, while establishing a construct to develop joint requirements, allowing both countries' cooperative dollars to go further. By fielding this advanced combat system, the submarine forces are able to employ the MK48 ADCAP CBASS. Due to the success of the first MOU, both governments signed ten-year continuations for these two programs on Nov. 20 and Oct. 28, 2009, respectively. Under the current MOUs, the U.S. and Australian submarine forces will oversee the evolutionary updating of hardware and software systems to meet their requirements.

The AN/BYG-1 is the first submarine combat control system to rely predominantly on commercial off-the-shelf (COTS) hardware and an open-architecture (OA) computing system; OA involves the use of public, consensus-based open standards, thereby providing an environment for stable, multi-vendor support. Combining COTS with OA allows the system to receive regular software and hardware upgrades at greatly reduced cost when compared to previous upgrade processes. Further, the AN/BYG-1's tactical and weapon control functions are segregated, allowing the Navy to upgrade one area without having to do a complete system test to ensure that the updates did not affect other areas of the system.

To provide regular capability and hardware upgrades to AN/BYG-1, the submarine forces utilize biennial technology insertions (TIs) and advanced processor builds (APBs), with each ship receiving, on

average, every other TI/APB. The TI/APB process allows for the rapid introduction of new capabilities into the Fleet, allowing ships to remain "state of the practice" and reducing the logistical tail inherent with legacy systems. These submarine systems and the TI/APB process fall under the Submarine Warfare Federated Tactical System (SWFTS) business model. The SWFTS program covers all non-propulsion electronic systems—including, but not limited to, sonar, tactical control, weapon control, imaging, electronic warfare, the radio room, and torpedoes—and it applies to all attack submarine classes as well as the U.S. Navy's four *Ohio*-class SSGNs.

The latest variant of the MK48 heavyweight torpedo—the CBASS—utilizes existing torpedo bodies, warheads and upgraded propulsion plants, as well as providing much-improved sonar and increased processor capacity that is required to operate effectively in shallow waters, where the ambient noise and volume of contacts are greater than in the open ocean.

To execute the CBASS and AN/BYG-1 projects, the U.S. and Australian navies established Joint Project Offices (JPOs) in Washington, D.C. Unlike Foreign Military Sales (FMS), wherein one country buys military products from another, the countries operating within a JPO participate as full and active partners contributing to the development, testing, fielding, and post-delivery support of the product. An added benefit of both countries fielding the same combat control system and torpedoes is increased interoperability.



Royal Australian Navy photo



U.S. Navy photo

(Opposite) The Australian submarine HMAS Waller (SSG 75).

(Above) Waller fired the first MK48 ADCAP CBASS warshot torpedo during RIMPAC 2008, sinking the ex-USS Fletcher (DD 992).

(Right) A MK48 ADCAP CBASS torpedo is loaded aboard Waller.



Royal Australian Navy photo

For instance, in a hypothetical wartime scenario, if the U.S. Navy were engaged in the Pacific and its deployed submarines ran low on torpedoes, they could pull into Australian submarine ports to reload. Similarly, if an Australian submarine were forward deployed and were experiencing issues with its AN/BYG-1, it could pull into a U.S. port for repairs. This significantly increases the potential range of submarines by increasing the support network for both countries' submarine forces. The success of the partnership was demonstrated on July 16, 2008, when the Australian submarine HMAS Waller (SSG 75) fired the first MK48 ADCAP CBASS warshot torpedo during that year's Rim of the Pacific (RIMPAC) exercise, sinking the ex-USS Fletcher (DD 992).

"The AN/BYG-1 and MK48 CBASS JPOs foster a mutually beneficial relationship with our partners in the U.S.," said Commodore Bronko Ogrizek, Director General for Submarines at the Australian Defence Materiel Organisation. "Both countries have made significant contributions to the programs' shared successes, and we look forward to an even closer partnership as the MOUs progress."

The AN/BYG-1 has been installed on three Collins-class diesel-electric submarines, one installation is currently underway, and the final two submarines of the class boats will receive the combat system in the coming years. The majority of the U.S. attack and guided missile submarine fleet is equipped with the AN/BYG-1 system, with the remaining upgrades currently being scheduled.

Royal Australian Navy Conducts Innovative Torpedo Tests

Leveraging existing U.S. Navy science and technology efforts, the Royal Australian Navy conducted seven Developmental Test (DT) firings of the MK48 Mod 7 ADCAP Common Broadband Advanced Sonar System (CBASS) torpedo in May 2010. The test firings represent an important milestone in the collaborative relationship between the U.S. and Australian Submarine Forces for their heavyweight torpedo and submarine combat systems. The U.S. Department of Defense and the Commonwealth of Australia DoD operate under a memorandum of understanding for the development, production and post-delivery support of the MK48 ADCAP CBASS and the AN/BYG-1 Submarine Combat System.

Distinguishing this test event from others, two of the seven fired torpedoes utilized an innovative tether-dispenser design for a fiber-optic guide wire system. The fiber-optic cable affords the torpedo increased bandwidth and performance over the traditional copper guide wire currently used. The test firings, from HMAS Waller (SSG 75), marked the first time this design has been demonstrated on an operational submarine. These developmental test firings are part of an ongoing series of tests conducted by the U.S. and Australian Submarine Forces to cooperatively evaluate the development and fielding of the torpedo and submarine combat system.



Photo courtesy of Northrop Grumman Shipbuilding

Christening a Submarine for the Golden State



PCU *California* (SSN 781), the U.S. Navy's newest attack submarine, was christened on Nov. 6 in a ceremony at Northrop Grumman Shipbuilding (now Huntington Ingalls Industries), in Newport News, Va. *California* is the eighth submarine of the *Virginia* class and the seventh ship to bear the name of the "Golden State." Her motto is "Silentium Est Aureum," Latin for "Silence is Golden."

Donna Willard, the ship's sponsor and wife of current Commander, U.S. Pacific Command, Adm. Robert F. Willard, performed the traditional honor of breaking a bottle of American sparkling wine against the submarine. Jackalyne Pfannenstiel, assistant secretary of the Navy for energy, installations and environment and a former chairman of the State of California Energy Commission, was the keynote speaker.

"To the men and women of Northrop

Grumman Shipbuilding, General Dynamics Electric Boat and the Navy's *Virginia*-Class Program, congratulations on another world-class submarine," said Pfannenstiel. "With her nuclear power, this sub demonstrates some of our [nation's] finest technical capabilities."

Also participating in the ceremony were U.S. Rep. Bobby Scott (D-Va.); U.S. Rep. Rob Wittman (R-Va.); Adm. Jonathan W. Greenert, vice chief of naval operations; Adm. Kirkland H. Donald, director, naval nuclear propulsion; Rear Adm. David Johnson, program executive officer for submarines; John Casey, president of General Dynamics Electric Boat; and Mike Petters, president of Northrop Grumman Shipbuilding.

"We know that the work we do is important," said Petters. "We know we are a critical part of the Navy-industry team that produces the most sophisticated and complex ships to

keep our nation safe. We know we have to earn our place on that team with each and every weld, with each and every pipe, and with each and every test. We do this by never losing focus on what our founder, Collis P. Huntington, committed to 125 years ago, when he promised, 'Always Good Ships'."

California honors the thousands of men and women from California who serve in today's armed forces and the millions of Californian veterans and their families. California is home to major naval and Marine Corps installations, so the selection of the state for a submarine name does not come as a surprise. San Diego has one of the world's largest concentrations of naval bases and facilities. Seven submarines—USS *Albuquerque* (SSN 706), USS *Asheville* (SSN 758), USS *Hampton* (SSN 767), USS *Helena* (SSN 725), USS *Jefferson City* (SSN 759), USS *San Francisco* (SSN 711), and USS *Topeka*



Photo courtesy of Northrop Grumman Shipbuilding

(Opposite) Donna Willard, sponsor of *California* (SSN 781), christens the submarine Nov. 6, 2010. (Above) *California* is launched on Nov. 13, 2010.

(SSN 754)—are currently homeported in San Diego at Naval Base Point Loma.

Eight days after her christening, *California* reached a significant construction milestone by successfully launching into the James River at Northrop Grumman Shipbuilding. On Nov. 11, shipbuilders used a transfer car system to move the ship out of the construction facility to the floating dry dock. Two days later, the floating dry dock was flooded, leaving the submarine afloat. Tugboats then moved *California* to the shipyard's submarine pier, where final outfitting and testing will take place.

"Launch is a special milestone in the life of a submarine. This is the first time she's put into water," said Becky Stewart, vice president of submarines and fleet support for Northrop Grumman Shipbuilding-Newport News. "*California* is 88 percent complete. This event means we're one step closer to

Students, STEM, and Submarines

In conjunction with *California's* christening, the U.S. Navy's Program Executive Office for Submarines (PEO SUB) sponsored three educational events in southern California during November aimed at encouraging young students to pursue careers in science, technology, engineering and mathematics (STEM).

One event was held at the Naval Surface Warfare Center in Corona, another at the Admiral Kidd Center on Naval Base Point Loma in San Diego, and the third at the California Science Center in Los Angeles. Over 1,000 students of middle school age, accompanied by teachers and parents, learned about submarines, science, robotics and other technological wonders.

"We're honored to host this public event for Californians as the Navy christens the first submarine for our state," said NSWC Corona Commanding Officer Capt. Jay Kadowaki. "This is a wonderful opportunity for our fellow residents to celebrate this historic occasion and an even greater opportunity for our young students to learn about the technologically advanced world that awaits them."

A signature feature of the events was the Mission Ocean Challenge, an interactive and collaborative teaching model sponsored by PEO SUB and developed by Purdue University Calumet's Center for Science and Technology Education. The year-long curriculum allows students to apply the math and science they learned in the classroom to driving a computer-generated research submarine on an underwater search for a volcano. The challenge teaches children about things like navigation, buoyancy and team work.

"In all three events, the students showed a tremendous amount of excitement and enthusiasm," said Dave Miskimins, director of undersea systems for PEO SUB. "It was amazing to see a room full of students cheering loudly for the speakers and for their submarine and then go completely silent as their peers demonstrated the Mission Ocean simulation."

The first STEM event occurred in conjunction with the christening of USS *Missouri* (SSN 780) in December 2009. With the three *California* christening events now completed, PEO SUB, Purdue Calumet, and their partners in California are looking forward to hosting similar gatherings when *California* commissions this fall. Historically, students who participate in Mission Ocean have scored significantly higher on standardized tests.

"It all comes down to getting students interested in STEM and showing them that they can have fun learning about these topics," said Rear Adm. Dave Johnson, program executive officer for submarines. "We in the acquisition community have a mandate from the Secretary of the Navy to increase our outreach efforts with STEM, and Mission Ocean has a proven track record for improving scores and showing students what a STEM-based job is like."

PEO SUB is also looking to bring Mission Ocean to Mississippi, Minnesota, and North Dakota, which are the other states with namesake *Virginia*-class submarines currently under construction.

delivering the ship well ahead of the contract delivery date."

California is being built under a teaming arrangement between Northrop Grumman Shipbuilding-Newport News and General Dynamics Electric Boat. Her construction began Feb. 15, 2006, with keel authentication occurring May 1, 2009. Most of the remaining construction work is related to compartment completion, pier-side testing

and exercising the ship's systems to prepare for sea trials, which are planned for this spring.

California is on schedule to be commissioned this fall. Cmdr. Dana A. Nelson, *California's* commanding officer, will lead a crew of approximately 134 officers and enlisted personnel.

Olivia Logan is managing editor of UNDERSEA WARFARE magazine.

In early March 1968, the Soviet ballistic submarine *K-129* was en route to the so-called Hawaiian Station, a holding position in the North Pacific beyond missile range of the submarine's assigned targets on the island of Oahu.

On March 11, two of her R-21 (NATO SS-N-4 Serb) missiles apparently ignited accidentally, sinking the sub with the loss of all 98 men on board.

When *K-129* failed to report as scheduled, the Soviet Navy launched a massive air, surface, and undersea search in the North Pacific. However, all they had to go on was the orders the missing sub had been given. They were unaware of what had happened to her and had only a vague idea where to look. In the vast expanse of the Pacific Ocean, their search turned up nothing.

Unbeknownst to the Soviets, U.S. remote sensing capability not only detected *K-129*'s loss but managed to locate where she went down.

The wreck lay at approximately 16,500 feet, far deeper than any existing U.S. salvage capability.

SALVAGING A SUBMARINE



However, the prospect of acquiring the one R-21 missile and warhead that appeared to remain intact, and perhaps even some cryptologic material, led the U.S. intelligence community to undertake a highly innovative effort to salvage the forward 130 feet of the submarine. (The roughly 100-foot after section, with the engineering spaces and after torpedo room, had broken off and lay about 100 yards away.)

The Central Intelligence Agency organized and directed the effort. After intensive discussions about how to raise almost 2,000 tons from such depth without tipping off Soviet surveillance, it was decided to (1) employ oil-drilling technology, with a pipe-string lowering a massive capture vehicle, or “claw,” to grasp and lift the wreck, and (2) to use a cover story that eccentric billionaire Howard Hughes was attempting to harvest manganese nodules from the seafloor. Ironically—and as expected—the name Hughes immediately attracted world-wide attention!

The project—code-named “Azorian,” with the general compartment name “Jennifer” to hide the specific operation—called for a massive salvage ship. It was designed by the firm Global Marine and its subsidiaries and built by the Sun Shipbuilding and Dry Dock Company in Chester, Penn. Sun was known for innovation, having built some of the first supertankers and roll-on/roll-off vehicle cargo ships constructed in the United States and converted the large tanker *Manhattan* for her two pioneering ice-breaking voyages through the Northwest Passage.

Sun began to build the new ship in May 1971. The design centered on a massive, fully enclosed internal docking well, called the “moon pool,” with closable gates across the bottom of the well. This prevented the ship from having a traditional keel—a main center-line structural member running along the bottom.

The ship, which employed technology developed for seafloor oil drilling, certainly appeared to be a deep ocean mining platform. Like a deep-water oil rig, she would take pipe sections stowed on deck and attach them to the top of a “drill string.” But instead of lowering a drill head, the drill string was supposedly intended to lower and raise a mining machine that would “vacuum up” manganese nodules from the ocean floor.

The ship’s actual mission pushed the technical state of the art in many ways. She would have to remain at a fixed position above the

three-mile pipe string despite the strong dynamic forces at work in the North Pacific, even in summer. The capture vehicle to be suspended at the end of a pipe-string weighed 2,000 tons. The combined weight of the vehicle and the sub section would be almost 4,000 tons, and the pipe string would weigh about the same. The entire mechanism would have to align perfectly to enter the bottom of the moon pool. And, of course, the recovery had to be unobservable by Soviet surveillance.

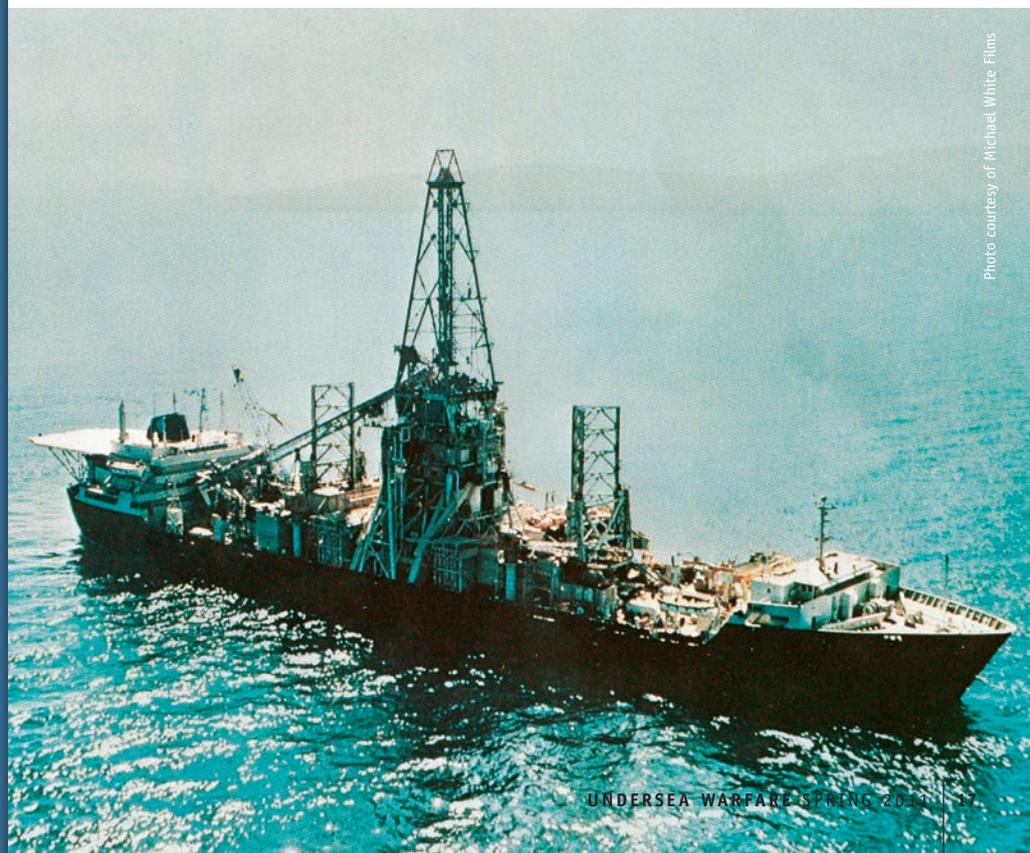
In addition to the moon pool, the ship’s most striking engineering features were:

- A dynamic positioning system with bow and stern thrusters to maintain station in a seaway.
- A massive gimballed platform to isolate the suspended load from the ship’s dynamic pitch and roll.

- A hydraulic/pneumatic heave compensation system to prevent the ship’s heave (vertical motion) from dynamically affecting the suspended load.
- An extremely powerful hydraulic hoisting system to lower and raise the load.
- Pipe-handling gear to convey pipe sections to and from the heavy-lift system.
- A docking system enabling the loaded capture vehicle to mate with the ship in a dynamic seaway.

Some of these features had previously been incorporated in drill ships, but never on a scale so large. For example, the outer ring of the gimballed platform was 40 by 40 feet, with four gimbal bearings of unique size and design, each with a capacity of 5,000 tons, to support a total weight of up to 20,000 tons. Similarly, the heave compensation

Internally the ship had all the comforts of a modern merchant ship and more. It accommodated 178 people, with single staterooms for senior ship and CIA officers, two-man staterooms for most of the crew, and four-man staterooms for the technical staff and “others.” In the modern kitchen and dining facilities, galley staff served up excellent food, and plenty of it.

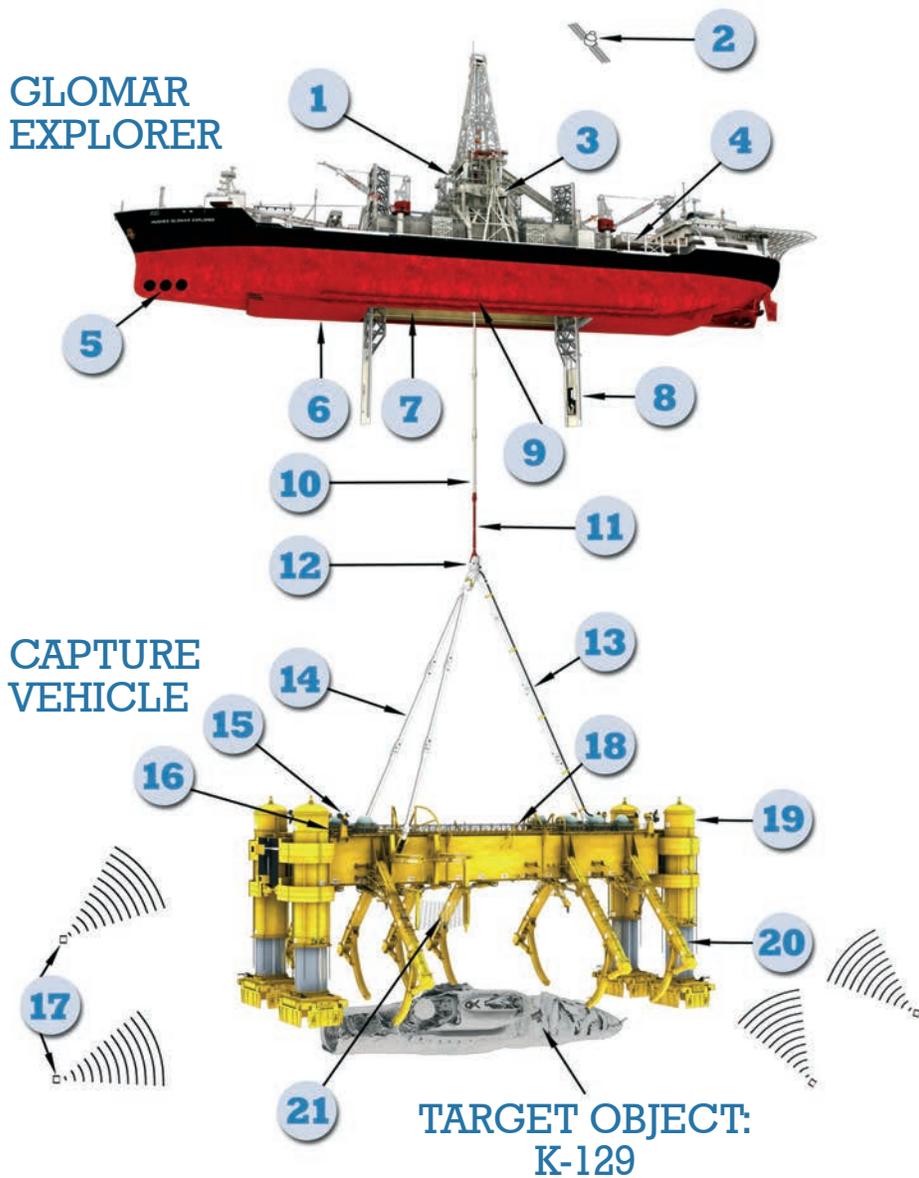


The Glomar Explorer at sea.

Photo courtesy of Michael White Films

Azorian System Concept

GLOMAR EXPLORER



CAPTURE VEHICLE

TARGET OBJECT:
K-129

- | | |
|-------------------------|-----------------------------|
| 1 Heavy Lift System | 12 Apex Block |
| 2 Satellite Navigation | 13 Hydraulic Line |
| 3 Gimbal Platform | 14 Bridle Assembly |
| 4 Control Centers | 15 Hydraulic Thrusters |
| 5 Positioning Thrusters | 16 Exelectric Yaw Thrusters |
| 6 Moon Pool Gates | 17 Transponders |
| 7 Moon Pool | 18 Search Sonar |
| 8 Capture Vehicle | 19 Breakout Legs |
| 9 Hydrophone Array | 20 Grabbers |
| 10 Pipe String | 21 Missile Containment Net |
| 11 Dutchman | |

system—essentially a giant spring—required two massive, hydraulic rams to mitigate the effect of heave on the suspended pipe-string.

The system could raise and lower the pipe at a constant speed of 18 feet per minute, although in the actual operation it would operate more slowly. Sixty-foot lengths of pipe totaling 17,000 feet and about 4,250 tons were stowed on board. The pipe-handling system could move them easily and continuously to the hoisting system or back to stowage, day or night, in almost any weather.

The docking system for the capture vehicle was also highly innovative. To stabilize the 4,000-ton load suspended from a single point (i.e., the pipe-string) in a dynamic seaway and hoist it into the narrow confines of the moon pool, it had two semirigid

(Below) The fully-enclosed docking well called the “moon pool,” around which the Hughes Glomar Explorer’s design was centered.

(Opposite) An outline sketch of the K-129 wreckage (top) based on the photo below.



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structural arms or “docking legs” that could be lowered beneath the hull, at either end of the docking well. These engaged massive “pins” at both ends of the capture vehicle and guided it up and into the center well. During docking and undocking, the 200-foot docking legs could tilt up to seven degrees fore and aft, facilitating recovery in a seaway. When not in use these docking legs retracted vertically and protruded up through the main deck, fore and aft of the pipe-hoisting system.

The mission required a huge ship—618 feet 8 inches long, with a beam of 115 feet 8-1/2 inches. The moon pool—sized to accommodate the capture vehicle carrying the approximately 130-foot forward section of *K-129*—was 199 feet long and 74 feet wide, with a minimum vertical clearance of 65 feet. Each of the two motor-driven doors or “gates” that slid along tracks to close the bottom was 9 feet thick, 80 feet wide, and some 80 feet long. Air pumped into the gates compressed a hard rubber

seal to make the bottom watertight so the moon pool could be pumped dry.

Internally the ship had all the comforts of a modern merchant ship and more. It accommodated 178 people, with single staterooms for senior ship and CIA officers, two-man staterooms for most of the crew, and four-man staterooms for the technical staff and “others.” In the modern kitchen and dining facilities, galley staff served up excellent food, and plenty of it.

The ship was launched at the Sun shipyard on Nov. 4, 1972, with Mrs. James R. Lesch, wife of the senior vice president of Hughes Tool Company, formally christening her the *Hughes Glomar Explorer*. She went to sea on builder’s trials on April 12, 1973. After some additional work to complete her, she sailed to deep water some 80 nautical miles northwest of Bermuda to test the automated station-keeping system and pipe-handling system. (Most of the three miles of pipe would not be loaded aboard until she reached her homeport of Long Beach, Calif.)

At this stage, the *Hughes Glomar Explorer* was still a “white ship,” with no classified equipment or material on board. Visitors saw only the unique and unusual features of the world’s first large, seafloor mining ship. The stated purpose of the massive moon pool was to carry and deploy the giant “vacuum cleaner” machine that would sweep up manganese nodules from the seafloor.

After a visit to Bermuda, the ship set sail for the Pacific and her rendezvous with the wreckage of the *K-129*. There, in early August 1973, the *Hughes Glomar Explorer*—with Soviet intelligence ships hovering close by the suspicious “mining operation”—successfully salvaged a part of the Soviet missile submarine, albeit losing a large part of the “target object” in the process.

Norman Polmar and Michael White are coauthors of *Project Azorian: the CIA and the Raising of the K-129* (Naval Institute Press, 2010); White, a film producer, also produced the film “Azorian: The Raising of the K-129.” (For more information, see www.projectjennifer.at.)

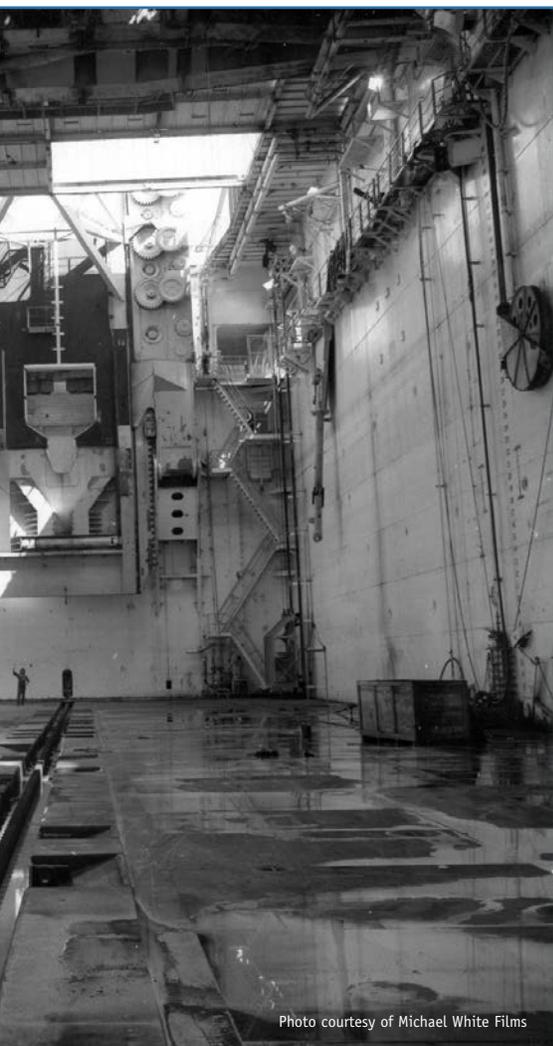
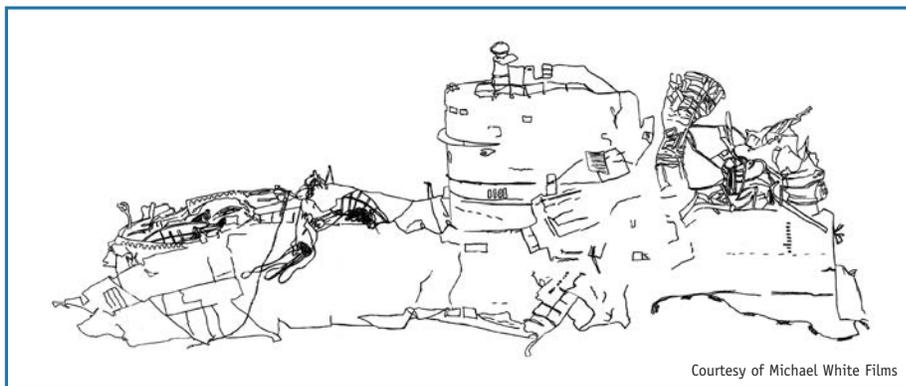


Photo courtesy of Michael White Films



Courtesy of Michael White Films



Courtesy of Michael White Films

Taking the Measure of the Battlespace

Satellite Altimetry's Vital Role in Undersea Warfare



Why Altimetry?

Any sailor can tell you that the surface of the sea is not flat. Ocean waves induced by winds and currents cause it to undulate with waves that range from less than a foot to massive hurricane swells the size of office buildings. In the background, there are also other undulations that are much less noticeable. Even when the ocean is perfectly calm, with no waves whatsoever, these underlying differences in height form gentle hills, ridges, and valleys similar to those on land.

However, these differences in altitude at sea are much smaller than on land, and the areas they cover are much larger. The ocean's "hills" and "valleys" differ in height by only a few meters, at most, over the course of many miles, which is why, even on windless days with a glass-smooth sea, the most discerning observer cannot perceive their gentle slopes with the naked eye.

The constant variation of sea surface topography—also called sea surface height, or altimetry—may seem like an esoteric scientific concern of interest only to oceanographers. The differences in surface height are much too small to have any direct effect on most day-to-day ship operations. For example, a "hill" of ocean water 50 nautical miles across and only six inches high has no effect on navigation either above or below the surface.

Nevertheless, the accurate, consistent, and repeated measurement of the ocean's surface plays a vital role in the U.S. Navy's undersea warfare effort. It does so because even small altitude differences greatly influence the direction and strength of sound energy as it moves through the water beneath the varying ocean terrain. Through complex physical processes, the water under areas of higher altitude tends to be moving downward, forcing the thermocline deeper in those areas. In areas of lower altitude, the reverse happens; with the thermocline being pulled upward toward the surface.



By applying known relationships between the height of the sea surface and the movement of the water below, it is possible to calculate the structure of the subsurface water column and thus its acoustic properties. By accurately measuring the ocean surface, we can calculate how acoustic energy will propagate through the water column and thus how the sonar systems of submarines and surface ships will perform against target vessels, regardless of whether the targets are nearby or far away.

The Challenge of Timeliness

But there's a catch. Just like analogous high and low pressure systems in the atmosphere, the ocean's "highs" and "lows"—its hills and valleys—do not just stay in one place, they constantly move around and change in size and shape depending on factors such as the water depth, wind, temperature and current.

For example, strong and swift western boundary currents like the Gulf Stream in the Atlantic and the Kuroshio Current in the Pacific constantly shed warm and cold core eddies that spin off from the main current. These eddies can produce fast-moving ocean features that can disrupt or focus sound energy and impact acoustic performance at scales that are tactically significant for naval operations.

Therefore, unlike terrain maps, which generally do not become outdated even after years without a new survey, mapping the constantly changing topography of the ocean surface requires remeasurement on the order of days to ensure that the information remains up to date and accurate. Revisiting mapped areas frequently and providing near-global broad ocean coverage are both key to successful ocean mapping.

The only sensors that can meet both the temporal and the spatial requirements for ocean mapping are radar altimeters operating from satellites. A radar altimeter is simple in concept, working in much the same way as any other radar. From the satellite, it directs a pulse of radio-frequency energy to the

target—in this case, a known location on the ocean surface beneath the satellite's flight path. Since the position of the radar and the velocity of the energy pulse are also known, the system can automatically calculate the height of the surface from the amount of the time it takes for the energy pulse to reach it and be reflected back up to the satellite.

Ozone and water vapor in the atmosphere can complicate this computation somewhat, but dealing with atmospheric complications is relatively simple. The real challenge is the overall process of mapping huge areas of the sea surface and relating the resulting information to sonar performance.

Current Altimetry Satellites

The U.S. Navy's own altimetry satellite, the GEOSAT Follow-On (GFO), was recently decommissioned and taken out of service after operating many years beyond its design life. Two other satellites now provide the U.S. Navy with all of its sea surface altimetry data. One of these is JASON-1, which is operated by a consortium of the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the French space agency. The other is the Envisat satellite, operated by the European Space Agency.

The loss of GFO raises concerns because it was the only altimetry satellite designed specifically to meet the Navy's requirement to capture features that impact undersea warfare operations and provide a complete picture of the ocean dynamics. JASON-1 and Envisat were both designed to monitor long-term climate change and are therefore in orbits less suitable to properly capture ocean features on the time and space scales that the Navy requires. Moreover, both are also operating past their designed life. The Navy is making good use of them, but it will continue to feel the loss of its primary ocean measuring system until a replacement can be launched in 2013.

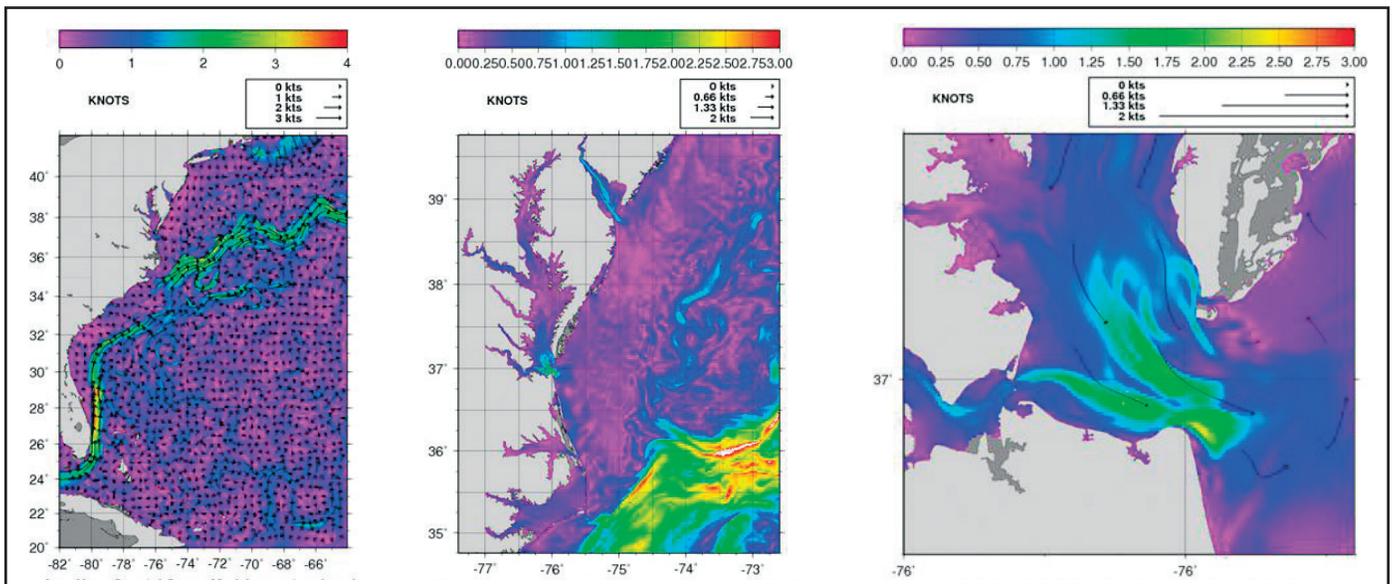
Predicting Undersea "Weather"

The Naval Oceanographic Office (NAVOCEANO) receives all of the Navy's—and most of the world's—real-time ocean data to feed its operational ocean models. Over 100 times more data comes from altimetry satellites than from all other sources of ocean data combined.

The data first enters NAVOCEANO through the Oceanographic Data Division. The job there is to receive the data, apply all necessary corrections and calibrations, and process it through a series of quality checks to ensure the values are correct and the collection system is working properly. The goal at this point is to ensure that the data is accurately depicting the current state of the ocean surface before it is passed to the next group, the ocean modelers, for further processing.

Collecting the data is just the first step in the process. The data represents the state of the ocean at some time in the near past, like yesterday or this morning. This is very useful information for building what are called historical climatologies—data bases that store data collected repeatedly in a given area for years. However, that is not NAVOCEANO's end game. Rather than merely collecting and storing sea surface data for later analysis, NAVOCEANO's goal is to provide information that will help submariners and other operators make successful decisions in the demanding real-time world of acoustic-driven operations.

Consequently, NAVOCEANO's final products are exactly analogous to local weather forecasts. The National Weather Service receives data from satellites and weather stations all over the country and uses it to forecast tomorrow's temperature and other atmospheric conditions in specific localities. When the weatherman refers to the average high and low temperatures for any given day, he is using output from a historical climatology. However, the actual highs and lows usually differ significantly from these climatological averages, so the



Example of ocean model output, with colors representing the velocity of ocean currents: (left) black arrows show the direction of surface currents in the Atlantic from Cuba to Cape Cod; (center) surface current speeds along the Virginia–Maryland–Delaware coast (a closer look at a portion of the image to the left.); (right) surface currents at the entrance to Chesapeake Bay. (a closer look at a portion of the center image.)

goal of the Weather Service is to provide accurate forecasts for specific locations at specific times.

The U.S. Navy cannot rely on historical averages alone for conducting real-world operations. Actual conditions usually differ greatly from averages based on historical data, and even a small change in underwater conditions can be very important, because it can make a huge difference in acoustic propagation. Near-term measurements of past conditions are therefore absolutely essential for predicting acoustic performance.

How Forecasting Works

Even near-term measurements are just data, however, until NAVOCEANO turns them into information by inputting this data into numerical ocean forecast models that can predict the state of the ocean in a future place and time where operations will occur. The real value of oceanographic data is its ability to reveal the shape of the ocean, which is much like the atmosphere, only denser, with high and low pressure systems that can reveal the location of currents and eddies, their potential velocity, and the water temperature. All of these are determiners of acoustic detection ranges.

Before the Navy had access to satellite altimetry data, submariners and other operators had to assume that the thermal structure of the water at a distant location they were observing with sonar was the same as the thermal structure of the water at their own

position. Oceanographers knew this wasn't the case, but they had no way to accurately estimate the critical properties of the water at any distance from a location where they could collect current data. Attempting to estimate conditions as little as a mile away from that specific location was merely guessing—educated guessing, perhaps, but still just guessing.

That all changed with satellite altimetry. According to Dr. Frank Bub, NAVOCEANO model and prediction system technical lead, nothing else provides as effective and complete a picture of the ocean as satellite altimetry—not buoys, and not ocean gliders. With altimetry, the location of each data point is known within centimeters, satellite passes come at regular intervals, and the data points are for exactly the same location pass after pass. Greg Jacobs, the model developer at the Naval Research Laboratory at Stennis Space Center, added that the model would not look like the real world without continuous data, since ocean features such as eddies, fronts, and currents cannot be predicted without a near constant stream of input.

From Data to Predictions

The Modeling Department at NAVOCEANO, with about 30 employees, models all of the world's oceans from the deep ocean to near-coastal areas continuously, 24 hours a day, 365 days a year. The modelers run three ocean models each day—a three-dimensional circulation model

run at both regional and global scales; a two-dimensional circulation model for near-coastal areas; and wave models run on every scale from global to the surf zone. The department also does special requests, which it prioritizes according to the operational load and mission priority.

Each day, the Modeling Department produces for the Fleet about 15,000 graphics that illustrate results of the model runs for various places in the world. “The Naval Oceanographic Office is the only organization in the world that provides fully dynamic global ocean forecasts out to 72 hours in the future,” Bub noted.

The forecasts that the Modeling Department produces after processing the altimetry data predict oceanographic conditions in the battlespace environment, but they do not yet show how the conditions in the forecasts will impact the Fleet's sonar systems. That is the job of NAVOCEANO's Acoustics Department. The acousticians take the data fields produced by the modelers and use them to make predictions that commanders can leverage to better understand how the environment impacts their mission.

Temperature and salinity affect the propagation of sound waves. Ocean currents shape and move water masses of different temperature and salinity, and therefore density, and these water masses directly affect the propagation of sound waves through the ocean. Analysts in the Acoustics Department observe the ocean properties that the predictive mod-

els show for a specific area and determine how those properties will affect sound waves.

The Acoustics Department runs acoustic propagation and performance models that combine the information on ocean conditions with sonar system design parameters to compute acoustic energy propagation for various sonars against different targets at different positions and depths. Predictions from the model runs are often condensed into a series of graphics, called “performance surfaces,” that provide operational commanders with an “acoustic map” of the battlespace informing them how their sensors will perform.

Ensuring Accurate Information for the Fleet

The final step in the processing chain is the Naval Oceanography Anti-Submarine Warfare Center (NOAC), which works directly with the Fleet in undersea warfare. NOAC’s uniformed Navy personnel use the results of the Acoustic Department’s acoustic analysis to brief operational commanders directly on potential sonar performance in their operational area.

Lt. Cmdr. Tim Campo, a former NOAC operations officer, said that his people have to be absolutely certain about the information that they are delivering. Any weak link in the chain—be it in the collection of satellite altimetry data, the fusion of that data, the running of ocean forecast models, or the prediction of acoustic system performance—adds to the uncertainty in the forecast acoustic performance products and reduces the accuracy of the acoustic performance briefs.

“We are about taking uncertainty out of the operation,” he said.

NAVOCEANO’s systematic effort to improve the quality of its forecasts now enables operational commanders to employ their forces, at least partially, on the basis of the NAVOCEANO “sonar performance surfaces.”

“We tell the Fleet operators how their sonar will perform in a specific area, Campo said. “Based on that information, operators place their assets and search for submarines.”

The Battlespace-on-Demand Doctrine

All Navy meteorology and oceanography support—in particular the support for undersea warfare described above—is accomplished in accordance with the Battlespace-on-Demand (BonD) doctrine, a ‘value chain’ approach to provide the Fleet with relevant

and actionable information on the physical battlespace environment and how it impacts operations and fielded systems. The BonD doctrine calls for three “tiers.”

Tier 1 is called the environment layer. This is where data from oceanographic sensors like a satellite altimeter is fed into numerical ocean models and formed into “nowcast” and forecast fields of data parameters like temperature, water density and sound speed that most influence sound propagation and thus acoustic sensor performance.

Tier 2, the performance layer, is where environmental data computed and delivered from Tier 1 is ingested into acoustic propagation and performance models to determine how a specific sonar system will operate against targets in those waters.

Tier 3 is the decision layer, where Tier 2 sonar performance is fused with other information about the tactical battlespace to create operational products on which operational commanders can base decisions.

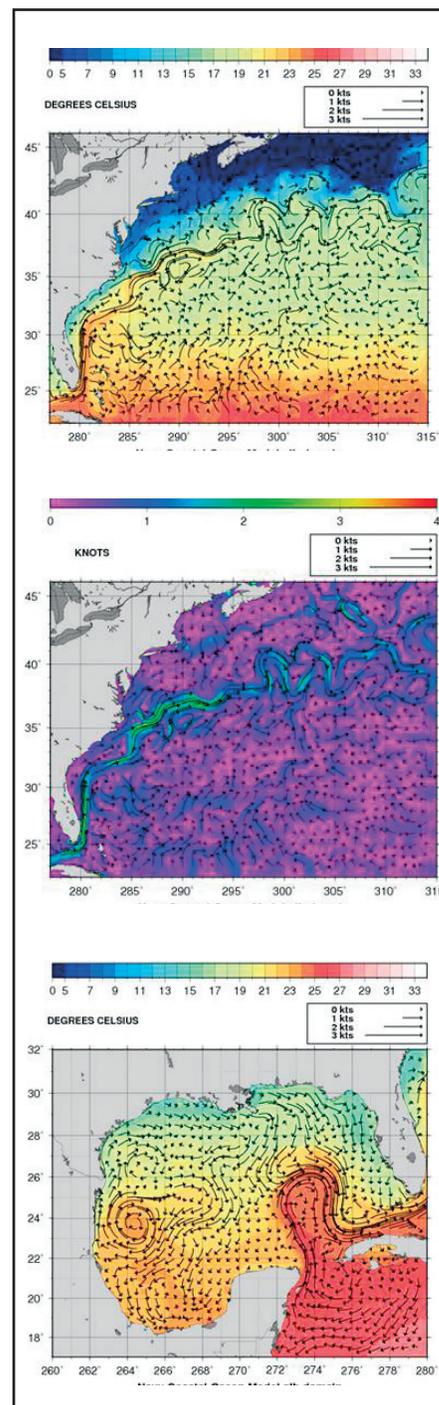
Each BonD tier is completely reliant on the one below it. The data collection itself, in this case, the sea height measurements that come from satellite altimeters, is the implied ‘Tier 0,’ the foundation on which all higher tiers and products rest. Without the satellites that constantly measure the ocean surface, those who are charged with defending America’s interests at sea would lack critical operational knowledge about the performance of their sonar systems.

The Foundation of It All

So the foundation of the entire process remains the continuous, real-time satellite measurement of something as esoteric as sea surface topography. The resulting data points are the basic building blocks for the modern ocean models that ultimately keep the Navy informed about how well—or even how poorly—its sonar systems will perform in any given place at any given time.

The systematic collection of altimetry data by satellites is the indispensable first step toward an accurate understanding of current conditions in the environment beneath the ocean’s surface. As such, it is absolutely essential for ensuring that U.S. Navy warfighters have the information they need to make effective operational decisions in the immensely complicated world of undersea warfare.

Ed Gough is deputy commander and technical director of the Naval Meteorology and Oceanography Command.



Example of ocean model output: (top) sea surface temperatures off the Atlantic coast from Florida to Nova Scotia; (center) ocean current velocities in the same area; (bottom) sea surface temperatures and currents in the Gulf of Mexico and western Caribbean Sea.

Doing Their Bit

British Subs in the War Against Japan

*This article is adapted from *The History of British and Allied Submarines in World War II*, by Vice Adm. Sir Arthur Hezlet.*

The fall of Britain's great naval base at Singapore on Feb. 15, 1942, exposed everything "east of Suez," to attack by the Imperial Japanese Navy, including Britain's Indian empire, oil shipments from the Persian Gulf, and even supplies for the British Eight Army in Egypt. Only American pressure in the Pacific kept the Japanese from wreaking greater havoc. The Royal Navy had its hands full closer to home. British submarines, for example, were busy hunting German U-boats, trying to get at menacing German "heavies" like the battleship *Tirpitz*, and cutting Axis supply lines in the Mediterranean. Half of the 94 Royal Navy (RN) submarines that served in the Mediterranean were lost. Forty-two failed to return from patrol, and German air raids destroyed another five, with men onboard, alongside at Malta.

In September 1943, the Italian Fleet surrendered, and explosives planted by British "X-craft" (four-man, 52-foot midget submarines) disabled *Tirpitz*. At last, the Royal Navy could begin to build up a Far Eastern fleet again. In mid-August, the Quebec Conference had established South East Asia Command (SEAC) to oversee all Allied operations in India (then including Pakistan and Bangladesh), Ceylon (now Sri Lanka), Burma, Malaya

(now Malaysia), the island of Sumatra, and a large part of the Indian Ocean, as well as future land operations in Thailand and French Indochina (now Vietnam, Cambodia and Laos). At the end of August, the British Admiralty had directed that all the new submarines of the *S* and *T* classes should be sent east. The first trickle of naval reinforcements to reach the new command was the Fourth Submarine Flotilla, consisting

of six boats dispatched from the Mediterranean.

They found plenty to do. Japanese light cruisers operated from Singapore, at the southern end of the Malacca Strait, and from Penang, at its northern end. Penang was also a base for Japanese submarines and for several German U-boats that had arrived from the Atlantic. Regular submarine patrols in the Strait at last gave British commanders some hope of detecting any Japanese move into the Indian Ocean. Patrols off Penang made it riskier for enemy subs to prey on Indian Ocean shipping, and the presence of British submarines made it harder for the Japanese to supply their army in Burma by the direct sea route to the port of Rangoon, forcing them to make greater use of the inefficient overland route through Thailand. Submarines were also ideal for landing and recovering agents in occupied territory and for conducting beach reconnaissance for future landings.

Eventually, RN submariners hoped to join the American anti-ship campaign in the Pacific. By late 1943, this was going extremely well. At the beginning

of the war the Japanese had just over six million tons of merchant shipping. By September 1943, U.S. submarines had sunk 2,248,000 tons. The 123 U.S. "fleet boats" operating from Pearl Harbor and from Australia were working in "wolf packs," making the best use of their high surfaced speed, radar, and VHF voice radio. Confined to SEAC's area of responsibility, the British Fourth Submarine Flotilla could attack Japanese shipping only in



Map showing the boundary between the British-led South East Asia Command and the American-led South West Pacific Area.

the Malacca Strait, northward as far as Burma, and off the southwest coast of Sumatra. (Even the Sunda Strait, at Sumatra's southern end, was assigned to the South West Pacific Area, a U.S. command.) RN submarines consequently found few targets other than coastal traffic.

On Feb. 24, 1944, the arrival in the Singapore area of the Japanese Main Fleet—three aircraft carriers, five battleships (among them the two giants *Yamato* and *Musashi*, with their 18-inch guns), and no less than 19 cruisers—promised some meaty trade for RN submarines, but this hope soon faded. It turned out that the Japanese had no offensive intention in the Indian Ocean, but were fleeing devastating American carrier attacks on their base at Truk earlier in February, which did immense damage despite failing to catch the Japanese fleet in harbor. The Main Fleet set up its new base in Lingga Roads, south of Singapore, which was safe from American air strikes and close to the Sumatran oil center at Palembang and the ex-British dockyard at Singapore.

Disappointed British submariners continued their anti-shipping campaign in the Malacca Strait. Although they sank relatively few ships in the first five months of 1944, it was a substantial proportion of the local traffic, leaving mostly small ships, coasters and craft such as junks to carry Japanese goods. With plenty of submarines to work the Strait and more arriving every month, RN submariners obviously needed to expand their operations into waters east of Singapore, where they could watch the Japanese Main Fleet at Lingga Roads and attack the main Japanese supply line to Burma, whose seaborne leg passed through the Gulf of Thailand. Those waters were in the South West Pacific Area, however, and RN submarines would need American consent to operate there.

American submarines sank 216 enemy ships totaling 964,121 tons in the first five months of 1944. In June, they sank another 48, for 195,020 tons, while all British sub-

marines could scour out of the Malacca Strait were four ships, for 7,719 tons. The targets were clearly in the American areas, and RN submariners were keen to participate. U.S. fleet boats were superior to British submarines in range, in speed and in their surface search radar, but they had one considerable disadvantage—their larger

use in shallow waters. The Allies eventually agreed that no British Pacific Fleet was required before 1945, but they also agreed that when SEAC received HMS *Wolfe*, its third submarine depot ship [tender], and its submarine strength reached 25 boats, it would dispatch a flotilla to operate from Fremantle, Australia, in the South West Pacific Area. The Royal Navy would provide all logistic support, and Commander, Submarines, U.S. Seventh Fleet, would have operational control. In August 1944, two groups totaling 14 submarines set out on patrol from the main British submarine base at Trincomalee, Ceylon. One group returned to Trincomalee. The other group—S-class submarines of the Eighth Flotilla—continued on to Fremantle.

Two other British submarines reached Fremantle about that time for specific missions. HMS *Porpoise*, a minelayer, was on a mission for Britain's Special Operations Executive (SOE) similar to one in 1943 that had sunk or seriously damaged seven Japanese ships totaling 39,000 tons. *Porpoise* was to carry a 21-man party to Singapore, where they would penetrate the defenses in motorized canoes called "Sleeping Beauties." Sadly, their cover was blown, and all 21 were killed or captured. None survived the war. HMS *Clyde*, an aging *River*-class boat with a distinguished record in Norway and the Mediterranean, was to land a large party from Force 136 (an SOE organization that supported local resistance against Japanese occupation) with considerable stores on the

east coast of Malaya. *Clyde* broke down and had to go into dock in Fremantle, but HMS *Telemachus* successfully replaced her.

Meanwhile, the Japanese Main Fleet had left Lingga Roads. After the June 1944 Battle of the Philippine Sea, the surviving Japanese aircraft carriers proceeded to Japan. Following the October 1944 Battle of Leyte Gulf, the remaining heavy surface forces retreated first to Brunei Bay and



HMS *Stygian* in surface action with a boarding party standing by.

size, which limited their ability to operate in the shallow water often encountered to the east of Singapore and in the Dutch East Indies (now Indonesia). British submariners felt they had an important role to play there.

Britain and the United States had been discussing a British Pacific Fleet since early 1943, and Adm. Ernest King, Commander-in-Chief, U.S. Fleet, was eager to have British submarines—especially the S-class—for

Courtesy of The Royal Navy Submarine Museum



XE Craft on the deck of HMS *Bonaventure*.

then to Japan. This left only four heavy cruisers at Singapore, two of them with serious battle damage. The Japanese also moved their submarine base from Penang to Batavia (now Jakarta), partly due to the difficulty of getting supplies, spare gear and torpedoes through the Malacca Strait, but mainly due to RN submarine attacks on Axis submarines entering and leaving Penang.

Submarines were now running out of merchant ships to sink not only in SEAC but also in the South West Pacific Area. In October, Japan abandoned the convoy route between Singapore and North Sumatra, a decision attributable almost entirely to British submarines. In January 1945, it finally gave up trying to get supplies through from Singapore to Rangoon, Burma. Only oil shipments from Sumatra to Singapore, Saigon, Formosa and Japan persisted. Although U.S. submarines sank 187 ships totaling 834,518 tons in the last four months of 1944, nearly all were sunk north of Borneo, around the Philippines and Indo-China, or near Japan. Not surprisingly, the Eighth Flotilla, at Fremantle, sank few ships during those months. Rear Adm. James Fife, Commander, Submarines, U.S. Seventh Fleet, emphasized the great value of their present work, especially in shallow waters, but they were eager to move north to the Philippines. At the end of January 1945, it was decided that they

should move up to Subic Bay in April. The Fourth Submarine Flotilla, with mostly *T*-class boats, would leave Trincomalee to relieve them at Fremantle.

By April, however, American submarines were also running out of targets, having sunk only 60 ships totaling 220,269 tons in the past three months. The Japanese merchant marine had fallen to only 2,465,000 tons (from 6,052,000 tons in 1941), and such traffic as put to sea stayed close to the Japanese home islands. The five remaining battleships and a few aircraft carriers lay camouflaged in coves on Japan's Inland Sea, with no fuel and no aircraft for the carriers. U.S. fleet boats kept busy protecting amphibious operations from attack by the remnants of the Japanese Navy, sweeping ahead of carrier forces to sink enemy picket boats and, above all, doing "lifeguard" duty, as the Americans called air-sea rescue. Meanwhile, there was some redistribution of RN submarine flotillas to Fremantle and Subic Bay.

On April 27, 1945, the submarine depot ship HMS *Bonaventure*, carrying improved "XE-craft" of the Fourteenth Submarine Flotilla (HMS XE1-6), arrived in Brisbane, Australia, having come from Britain via the Panama Canal, San Diego, and Pearl Harbor. Like previous X-craft, the XEs had a four-man complement: the captain, two crewmen, and a diver. While *Bonaventure* was crossing the Pacific, how-

ever, Commander in Chief, U.S. Pacific Fleet, decided he had no use for such craft. C-in-C, British Pacific Fleet, reluctantly concurred and sent the ship to Brisbane to await orders.

The battleships and aircraft carriers hiding in Japan's Inland Sea were obvious targets for the X-craft, and British boats now in the Philippines could have towed them to Japan. In the successful X-boat attack on *Tirpitz*, however, the British crews had all been killed or taken prisoner, and although every craft had returned from a subsequent attack, the American high command regarded all X-craft almost as suicide machines—an unnecessary sacrifice at this stage of the war. It must also be said that the U.S. Navy felt that it, not the Royal Navy, should have the honor of finishing off the Imperial Japanese Navy, both as restitution for Pearl Harbor and as the culmination of its hard-fought Pacific campaigns. U.S. carrier forces, in particular, considered the last major Japanese ships "their bird."

At the time, such notions were understandable, but it was devastating to the officers and men of the Fourteenth Flotilla not to put all the years of X-craft training and development to a final test. They had simply arrived too late. A year earlier, the Americans might have welcomed an attack on the Japanese surface fleet at Lingga, but only the battleship *Yamato* could still pose a significant threat, and U.S. carrier aircraft had sunk her on April 7. Plans were therefore made to scrap the six XE-craft in Australia and to use *Bonaventure* in the fleet train of the British Pacific Fleet.

In the meantime, British submarines kept up anti-shipping patrols to discourage any Japanese ship movement, carried out special operations, and did air-sea-rescue duty. They also patrolled in distant support of amphibious operations such as the invasion of North Borneo and the landings at Rangoon, and they joined U.S. submarines in trying to prevent the Singapore-based Japanese cruisers from bringing in troops from outlying islands. USS *Charr* (SS-328) sank the cruiser *Isuzu* in early April, and in early June, HMS *Trenchant* sank *Ashigara* north of the Banka Strait in less than 20 fathoms of water, hitting the target with five torpedoes out of a salvo of eight. That left two cruisers at Singapore: *Takao* and *Myoko*, both damaged at Leyte Gulf. *Takao* had not moved for six months or so, but the dockyard at Singapore might have repaired her enough

to put to sea. *Myoko* had made an attempt to reach Japan before Christmas 1944 but was torpedoed by USS *Bergall* (SS-320) and forced back to Singapore.

Capt. William Fell, commanding Submarine Squadron Fourteen in *Bonaventure*, had never ceased to look for an opportunity to use his X-craft. At a staff meeting in June, he heard of a requirement to cut the undersea telegraph cables between Singapore, Saigon and Hong Kong. This would force the Japanese to communicate solely by radio, enabling the Allies to intercept and decrypt any message they sent. Capt. Fell got permission from C-in-C, British Pacific Fleet, to fly to the Philippines to discuss the matter with Commander, U.S. Seventh Fleet, and his submarine commander, Rear Adm. Fife. Subsequent trials off Brisbane, in the Great Barrier Reef, convinced all concerned that X-craft could locate and cut the cables, and plans were made to mount the operation toward the end of July.

On July 20, *Bonaventure* arrived with her X-craft in Subic Bay, where Fife and his staff participated enthusiastically in drawing up detailed plans for the attacks, which were now to include not only cutting cables at Hong Kong and Saigon but also sinking the two Japanese cruisers at Singapore, which were lying in the narrow Johore Strait. Neither ship had moved for some months, but repairs might be underway, and they might even be operational to some extent. This potentially posed a threat to British landings in Malaya planned for September, so it was prudent to put them out of action for good.

HMS *Bonaventure* hoisted Rear Adm. Fife's flag before departing Subic to meet the four towing submarines from Eighth Flotilla at Brunei Bay, now in Allied hands. On July 26, HMS *Spark*, towing XE1, and HMS *Stygian*, towing XE3, sailed for Singapore. HMS *Spearhead*, towing XE4, sailed the same day for Saigon, while HMS *Silene*, with XE5, left for Hong Kong the following day. XE2 and XE6 remained on *Bonaventure*, having been held in reserve in case one of the others needed replacement. All four towing submarines slipped their X-craft on the night of July 30-31, on time and in the right places. XE3 penetrated the Johore Strait and found *Takao* without difficulty. She laid a two-ton "side charge" underneath the cruiser, despite the difficulty of working in the narrow space above the shallow bottom, and placed limpets on the hull. The diver could not get the second



XE3's crew onboard the towing submarine HMS *Stygian* on the Singapore operation. Her diver, J.J. Magennis (left), and captain, Lt. I.E. Fraser (second from right), received the Victoria Cross.

side charge to release from the craft and had to cut—or rather, bludgeon—it free. XE3 then withdrew.

XE1's target was *Myoko*, lying higher up the Strait than *Takao*, but adverse tides and patrol craft delayed XE1, so she followed XE3 instead of preceding her. Given the delay, XE1's captain calculated that XE3's charges would explode before he could get back past *Takao*. Rather than risk passing just as XE3's charges exploded, he decided to forego *Myoko* and ensure *Takao*'s destruction. The shallow depth prevented him from placing his charges under *Takao*, so he laid them close alongside. Both craft withdrew successfully and were picked up by *Spark* and *Stygian*. The explosions caused *Takao* to subside onto the shallow bottom, which prevented her from sinking altogether. XE3's captain and diver both received the Victoria Cross.

Spearhead slipped XE4 14 miles from Cape St. Jacques, off Saigon. The craft successfully grappled and cut both the cable to Hong Kong and the one to Singapore, bringing a one-foot length of each back to her rendezvous with *Spearhead*. *Selene* slipped XE5 off Hong Kong to cut the Hong Kong-Singapore cable west of Lamma Island, but deep mud made locating and cutting it very difficult, and after three and a half days, XE5 gave up the attempt. It was later found that she had damaged the cable sufficiently to put it out of action. Carried out with great skill and bravery, the operations at Singapore, Saigon, and Hong Kong had all succeeded without casualties either of personnel or material.

British submarines, although operating in the shadow of the victorious U.S. Submarine

Force, had done well against Japan. They arrived too late to sink many Japanese ships, but they nevertheless contributed substantially. They prevented Japanese forces in Burma from receiving supplies by sea. After joining the Americans in Fremantle, their ability to operate in very shallow water helped sustain what amounted to a universal blockade of Japanese shipping.

The low tonnage that British submarines sank in the Far East was balanced by extraordinarily low casualties. Britain lost 47 submarines in the Mediterranean and 24 in home waters, but only three in the Far East. Only one was definitely attributed to the Japanese Navy, the fate of the other two being unknown. Six other submarines suffered serious damage that they were lucky to survive. The low casualties were not due to avoiding risk, as witness the number of attacks where RN submarines ran aground just before or after firing. Credit must go both to the toughness of the submarines themselves and to the excellent training and battle-worthiness of crews already hardened in Norway and the Mediterranean.

Cmdr. Tall, a veteran of the Falklands War, commanded the conventional submarines HMS *Olympus* and *Finwhale*, the nuclear attack submarine HMS *Churchill* and the nuclear ballistic missile submarine HMS *Repulse*. After retiring, he served as the director of the Royal Navy Submarine Museum from 1994 to 2008. The RN Submarine Museum published Vice Adm. Hezlet's authoritative two-volume account of World War II submarine operations. (Hezlet's own exploits included sinking a German U-boat off Sumatra and the daring sinking of the Japanese cruiser *Ashigara* mentioned in this article.)

U.S. and U.K. Submarines Help Clear the Air over Libya

Starting March 19, American and British submarines helped open the door for joint and coalition aircraft to establish a no-fly zone in Libya and shield Libyan civilians from the military forces of Muammar Gaddafi. In coordination with the guided missile destroyers USS *Stout* (DDG 55) and USS *Barry* (DDG 52), the guided missile submarine USS *Florida* (SSGN 728) and the attack submarines USS *Providence* (SSN 719), USS *Scranton* (SSN 756), and HMS *Triumph* (S 93) launched Tomahawk missiles to knock out air defenses and communication nodes that could prevent U.S. and allied aircraft from operating freely over Libya.

Operation Odyssey Dawn marked the first combat launch of a Tomahawk missile from an SSGN. Deploying with 105 Tomahawk missiles, *Florida* has a Tomahawk capacity equivalent to more than two guided missile destroyers or eight SSNs. According to Secretary of the Navy, Ray Mabus, "On the first day, the majority of U.S. Navy Tomahawks that were fired on Libya came off [*Florida*]."



Photo by Petty Officer 2nd Class Daniel Viramontes



Photo by Seaman Apprentice Cameron Bramham



U.S. Navy photo

(Top to bottom) *Florida* in the Bay of Naples March 4; *Scranton* off Sicily March 6; *Providence* begins her deployment last October.

Changes of Command

COMSUBPAC

Rear Adm. James F. Caldwell relieved Rear Adm. Douglas J. McAneny

COMSUBGRU NINE

Rear Adm. Robert M. Hennegan relieved Rear Adm. James F. Caldwell, Jr.

USS Henry M. Jackson (SSBN 730) (B)

Cmdr. Mark D. Behning relieved Cmdr. James Bilotta

USS Pennsylvania (SSBN 735)

Cmdr. Gustavo Gutierrez relieved Cmdr. Theodore Schroeder

USS Ohio (SSGN 726) (B)

Cmdr. Theodore H. Schroeder relieved Capt. R. M. Gero, Jr.

USS Florida (SSGN 728) (B)

Capt. Gregory M. Ott relieved Capt. Randy B. Crites

USS Maryland (SSBN 738) (G)

Cmdr. Andrew J. Kimsey relieved Cmdr. Jeffery M. Grimes

USS Key West (SSN 722)

Cmdr. Curtis Duncan relieved Cmdr. Robert Koonce

USS Ohio (SSGN 726) (B)

Capt. Brian Humm relieved Cmdr. Theodore Schroeder

USS Henry M. Jackson (SSBN 730) (B)

Cmdr. Matthew D. Terwilliger relieved Cmdr. Eugene J. Nemeth

USS Jacksonville (SSN 699)

Cmdr. Nathan Sukols relieved Cmdr. Tyler Meador

USS Jefferson City (SSN 759)

Cmdr. Brian Dixon relieved Cmdr. Edward Anderson

USS Topeka (SSN 754)

Cmdr. Jim Belz relieved Cmdr. Michael Bratton

USS Olympia (SSN 717)

Cmdr. Michael Boone relieved Cmdr. Michael Coughlin

USS Tucson (SSN 770)

Cmdr. James E. O'Harrach relieved Cmdr. Gary Pinkerton

Arco (ARDM 5)

Lt. Cmdr. Mack Schmidt relieved Lt. Cmdr. Raymond Spears

Naval Submarine Support Command

Cmdr. Brett Fillmore relieved Capt. William Stevenson

Qualified for Command

Lt. Cmdr. Rex Boonyobhas
COMSUBGRU NINE

Lt. Cmdr. William Bundy
USS Hampton (SSN 767)

Lt. Cmdr. William E. Callahan
COMSUBRON SIX

Lt. Cmdr. John Correll
TRITRAFAC Bangor

Lt. Cmdr. Sean Donaghay
COMSUBRON SEVENTEEN

Lt. Cmdr. Jamie Edens
USS Columbia (SSN 771)

Lt. Cmdr. Roger Ferguson
USS Louisiana (SSBN 743) (G)

Lt. Cmdr. Travis W. Haire
COMSUBRON TWENTY

Lt. Cmdr. Sterling S. Jordan
COMSUBRON TWENTY

Lt. Cmdr. Marc Kennedy
DSU San Diego

Lt. Cmdr. Joe Lautenslager
USS Philadelphia (SSN 690)

Lt. Cmdr. Daniel McAuliffe
USS Columbus (SSN 762)

Lt. Cmdr. Jesse Pruett
COMSUBPAC Staff

Lt. Cmdr. David J. Rogers
COMSUBDEVRON TWELVE

Lt. Cmdr. Robert Rose
COMSUBRON ELEVEN

Lt. Cmdr. Steven Tarr
USS Connecticut (SSN 22)

Lt. Brandon Oberling
COMSUBRON SIXTEEN

Lt. Benjamin C. Pollock
USS Michigan (SSGN 727) (B)

Lt. Douglas Pratt
USS Michigan (SSGN 727) (B)

Lt. Timothy Williamson
COMSUBRON SIXTEEN

Qualified Nuclear Engineering Officer

Lt. Bradford Bonney
USS Jefferson City (SSN 759)

Lt. Andrew Cole
USS Jimmy Carter (SSN 23)

Lt. Donald Coomes
USS Alabama (SSBN 731) (G)

Lt. Andrew Courts
USS Henry M. Jackson (SSBN 730) (G)

Lt. Peter Daderko
USS Maine (SSBN 741) (G)

Lt. Christopher Deigel
USS Louisville (SSN 724)

Lt. Justin Hamilton
USS Columbus (SSN 762)

Lt. Benjamin Hegler
USS Pasadena (SSN 752)

Lt. Christopher Heine
USS La Jolla (SSN 701)

Lt. Matthew Hezel
USS Nevada (SSBN 733) (B)

Lt. Roy Johnston
USS Asheville (SSN 758)

Lt. Douglas Keel
USS Nebraska (SSBN 739) (G)

Lt. Cullen Matthews
USS Michigan (SSGN 727) (G)

Lt. Eric Roe
USS Columbia (SSN 771)

Lt. Steven Sanchez
USS Asheville (SSN 758)

Lt. Todd Williamson
USS Maine (SSBN 741) (G)

Lt. Daniel Zastrow
USS Albuquerque (SSN 706)

Lt. j.g. Christopher Abplanalp
USS Kentucky (SSBN 737) (G)

Lt. j.g. Gregory Barnekoff
USS La Jolla (SSN 701)

Lt. j.g. Hunger Barns
USS Kentucky (SSBN 737) (B)

Lt. j.g. Anthony Bracalente
USS Charlotte (SSN 766)

Lt. j.g. Samuel Booth
USS Ohio (SSGN 726) (B)

Lt. j.g. Seth Cairo
USS Asheville (SSN 758)

Lt. j.g. Kevin Campbell
USS Seawolf (SSN 21)

Lt. j.g. Chance Carter
USS Columbia (SSN 771)

Lt. j.g. Jeremy Carroll
USS Chicago (SSN 721)

Lt. j.g. Benjamin Cavin
USS Nebraska (SSBN 739) (B)

Lt. j.g. Timothy Chadwick
USS Ohio (SSGN 726) (B)

Lt. j.g. John Chester
USS Tucson (SSN 770)

Lt. j.g. Thomas Cohenno
USS Jacksonville (SSN 699)

Lt. j.g. Michael Deboer
USS Ohio (SSGN 726) (G)

Lt. j.g. Francis Decambra
USS Pennsylvania (SSBN 735) (B)

Lt. j.g. Jeffrey Dudgeon
USS Chicago (SSN 721)

Lt. j.g. Ryan Haskins
USS Maine (SSBN 741) (G)

Lt. j.g. Christopher Hammonds
USS Key West (SSN 722)

Lt. j.g. John Heden
USS Jefferson City (SSN 759)

Lt. j.g. Michael Humara
USS Louisville (SSN 724)

Lt. j.g. Randall Jagoe
USS Texas (SSN 775)

Lt. j.g. Damiean Johnson
USS Houston (SSN 713)

Lt. j.g. Farrokh Kapadia
USS Cheyenne (SSN 773)

Lt. j.g. Ryan Kelley
USS Buffalo (SSN 715)

Lt. j.g. Kevin Kerno
USS Alabama (SSBN 731) (B)

Lt. j.g. Thomas Kiernan
USS Tucson (SSN 770)

Lt. j.g. Peter Koziol
USS Jefferson City (SSN 759)

Lt. j.g. Joshua Lail
USS Chicago (SSN 721)

Lt. j.g. Christopher Lambert
USS Columbia (SSN 771)

Lt. j.g. Paul Lenz
USS Kentucky (SSBN 737) (G)

Lt. j.g. Nels Lingberg
USS Jimmy Carter (SSN 23)

Lt. j.g. Noah McBurnett
USS Houston (SSN 713)

Lt. j.g. Tristan Monroe
USS Texas (SSN 775)

Lt. j.g. Ryan Moore
USS City of Corpus Christi (SSN 705)

Lt. j.g. Adam Oliveira
USS Buffalo (SSN 715)

Lt. j.g. Jonathan Otten
USS Michigan (SSGN 727) (B)

Ohio Replacement Achieves 'Milestone A'

by Program Executive Office for Submarines

The *Ohio*-class submarine replacement program received 'Milestone A' approval from the Defense Acquisition Board, enabling it to enter the technology development phase of the Department of Defense life cycle management system as of Jan. 10. During the technology development phase, the program will establish requirements and continue design and technology development efforts that will ultimately lead to a ship construction contract.

"The Navy is committed to ensuring that an affordable replacement ballistic missile submarine is designed, built, and delivered on time with the right capabilities to sustain the most survivable leg of our triad for many decades to come," said Program Executive Officer for Submarines Rear Adm. Dave Johnson.

The Defense Acquisition Board endorsed replacing the current 14 *Ohio*-class ballistic-missile submarines as they reach the end of their service life with 12 *Ohio* replacement submarines, each with 16 87-inch missile tubes, in an acquisition decision memorandum. Lead ship procurement is scheduled for 2019.

Lt. j.g. Jason Paradis
USS Key West (SSN 722)

Lt. j.g. Benjamin Pitre
USS Olympia (SSN 717)

Lt. j.g. Christopher Prost
USS Louisiana (SSBN 743) (B)

Lt. j.g. Michael Rocco
USS Michigan (SSGN 727) (B)

Lt. j.g. David Rodes
USS Louisiana (SSBN 743) (B)

Lt. j.g. Jason Rogers
USS Ohio (SSGN 726)

Lt. j.g. John Seebode
USS Cheyenne (SSN 773)

Lt. j.g. Philip Shrader
USS Pasadena (SSN 752)

Lt. j.g. Jeremiah Shumway
USS Maine (SSBN 741) (G)

Lt. j.g. Andrew Siddons
USS Buffalo (SSN 715)

Lt. j.g. John Sines
USS Santa Fe (SSN 763)

Lt. j.g. Andrew Streenan
USS Topeka (SSN 754)

Lt. j.g. Michelangelo Vaccaro
USS Cheyenne (SSN 773)

Lt. j.g. Nicolaas Verhoeven
USS Bremerton (SSN 698)

Lt. j.g. Michael Wells
USS Alabama (SSBN 731)

Lt. j.g. Brian Wilson
USS Jimmy Carter (SSN 23)

Lt. j.g. Aaron Woodside
USS Kentucky (SSBN 737)

Line Officer Qualified In Submarines

Lt. Charles Allen III
USS Oklahoma City (SSN 723)

Lt. Andrew Courts
USS Henry M. Jackson (SSBN 730) (G)

Lt. Joseph Leonelli
USS Connecticut (SSN 22)

Lt. Jonathan Lim
USS Santa Fe (SSN 763)

Lt. Edward Windas
USS Olympia (SSN 717)

Lt. j.g. Kerry Ames
USS Hawaii (SSN 776)

Lt. j.g. Gregory Andrew
USS Hampton (SSN 767)

Lt. j.g. Manuel Caballero
USS Topeka (SSN 754)

Lt. j.g. Jason Carroll
USS Jefferson City (SSN 759)

Lt. j.g. Patrick Cashin
USS Seawolf (SSN 21)

Lt. j.g. Thomas Cohenno
USS Jacksonville (SSN 699)

Lt. j.g. James Defazio
USS Olympia (SSN 717)

Aloha and Welcome Home, *Hawaii*!

The *Virginia*-class attack submarine USS *Hawaii* (SSN 776) returned to her homeport, Joint Base Pearl Harbor-Hickam, on Feb. 24 after a six-month scheduled deployment to the Western Pacific, the first time a *Virginia*-class submarine had visited that region.

Hawaii departed Pearl Harbor on Aug. 25, 2010. Her first stop was the Philippine Sea, where she joined other units assigned to the U.S. Pacific Command in Exercise Valiant Shield 2010, a multifaceted exercise designed to hone joint forces' ability to locate, track and engage units at sea, in the air, on land and in cyberspace.

After a port visit to Guam, *Hawaii* teamed up with the *Abraham Lincoln* Carrier Strike Group for an anti-submarine warfare exercise. The crew of USS *Shoup* (DDG 86) called *Hawaii* a "formidable opponent" that enabled them "to prove their abilities against a live submarine 'adversary' of considerable skill."

Hawaii also made port visits to Yokosuka, Japan in early September, Busan, South Korea in November, and Singapore in mid-January, in support of the 7th Fleet's commitment to growing maritime partnerships and its enduring commitment to peace and stability in the Asia-Pacific region.

"*Hawaii* exceeded all expectations and demonstrated the myriad capabilities the *Virginia*-class submarine brings to the challenging Western Pacific environment," said Cmdr. Steve Mack, *Hawaii*'s commanding officer, adding that she "has set the stage for the success of future *Virginia*-class deployments."



Hawaii (SSN 776) arrives in Busan for a routine port visit. The visit marked the first time a *Virginia*-class submarine visited the Republic of Korea.

Lt. j.g. Brett Desmond
USS Alabama (SSBN 731) (B)

Lt. j.g. Matthew Dunn
USS Columbia (SSN 771)

Lt. j.g. Stephen M. Emerson
USS Houston (SSN 713)

Lt. j.g. Kyle E. Fancher
USS Florida (SSGN 728)

Lt. j.g. Christopher N. Foss
USS Maryland (SSBN 738)

Lt. j.g. Mark Gordon
USS Scranton (SSN 756)

Lt. j.g. Kyle Haubold
USS Jacksonville (SSN 699)

Lt. j.g. Carlos Iguina
USS Topeka (SSN 754)

Lt. j.g. David Jordan
USS Jacksonville (SSN 699)

Lt. j.g. Nick Kasatkin
USS Houston (SSN 713)

Lt. j.g. Jonathan Kassoff
USS Jacksonville (SSN 699)

Lt. j.g. Alfred Keller
USS Alabama (SSBN 731) (B)

Lt. j.g. Kevin Kerno
USS Alabama (SSBN 731) (B)

Lt. j.g. Joel King
USS Columbia (SSN 771)

Lt. j.g. David Koeppel
USS Alabama (SSBN 731) (B)

Lt. j.g. Daniel A. Kohnen
USS Columbus (SSN 762)

Lt. j.g. Matthew H. Krieger
USS Hampton (SSN 767)

Lt. j.g. Andrew Lawrence
USS San Francisco (SSN 711)

Lt. j.g. Jason G. Mangin
USS Philadelphia (SSN 690)

Lt. j.g. Timothy Marshall
USS Seawolf (SSN 21)

Lt. j.g. Eric Marx
USS Asheville (SSN 758)

Lt. j.g. Joseph P. R. Milo
USS Florida (SSGN 728)

Lt. j.g. Joseph Nutting
USS Connecticut (SSN 22)

Lt. j.g. Gregory Pappianou
USS Albuquerque (SSN 706)

Lt. j.g. James Pearson
USS Seawolf (SSN 21)

Lt. j.g. Benjamin Rosenbaum
USS Jefferson City (SSN 759)

Lt. j.g. Kevin S. Ryan
USS Montpelier (SSN 765)

Lt. j.g. Christopher Schmitt
USS Chicago (SSN 721)

Lt. j.g. Andrew W. Siddons
USS Buffalo (SSN 715)

Lt. j.g. Brian R. Sisk
USS Asheville (SSN 758)

Lt. j.g. Nicholas Smith
USS Albuquerque (SSN 706)

Lt. j.g. Steven Stead
USS San Francisco (SSN 711)

Lt. j.g. Adam N. Swett
USS Seawolf (SSN 21)

Lt. j.g. Brendan Tower
USS Hawaii (SSN 776)

Lt. j.g. Brian L. Tribbitt
USS Maryland (SSBN 738)

Lt. j.g. Richard K. Vagts
USS Maryland (SSBN 738)

Lt. j.g. Luke R. Wolf
USS Alaska (SSBN 732)

Lt. j.g. Christopher Wood
USS Kentucky (SSBN 737) (G)

Lt. j.g. Aaron Woodside
USS Kentucky (SSBN 737) (G)

Ensign Joshua A. Andrews
USS Florida (SSGN 728)

Limited Duty Officer Qualified in Submarines

Lt. j.g. Alexander Marsh
USS Cheyenne (SSN 773)

Supply Officer Qualified in Submarines

Lt. j.g. Christian Buensuceso
USS Greenville (SSN 772)

Lt. j.g. Daniel J. Johnston
USS Alaska (SSBN 732)

Lt. j.g. Lonny McLeod
USS Scranton (SSN 756)

Lt. j.g. John McNeil
USS Rhode Island (SSBN 740)

Lt. j.g. Lucas Schaible
USS Connecticut (SSN 22)

Lt. j.g. Tucker Taylor
USS Topeka (SSN 754)

Lt. j.g. Julio Vargas
USS Alabama (SSBN 731) (B)

Lt. j.g. William Wright
USS Louisville (SSN 724)

Ensign Charles W. Guire
USS West Virginia (SSBN 736)

**Special Recognition—
Battle “E” Winners**

USS Albany (SSN 753)

USS Alexandria (SSN 757)

USS Boise (SSN 764)

USS Florida (SSGN 728) (Blue)

USS Florida (SSGN 728) (Gold)

USS Hampton (SSN 767)

USS Hawaii (SSN 776)

USS Houston (SSN 713)

USS Jacksonville (SSN 699)

USS Michigan (SSBN 727) (Blue)

USS Nebraska (SSBN 739) (Blue)

USS Nebraska (SSBN 739) (Gold)

USS Pittsburgh (SSN 720)

USS Rhode Island (SSBN 740) (Blue)

USS Rhode Island (SSBN 740) (Gold)

USS Tucson (SSN 770)

USS Virginia (SSN 774)

USS Frank Cable (AS 40)

Floating Dry Dock Arco (ADRM 5)

Torpedo Weapon Retriever
Swamp Fox (TWR 821)



Photo by Petty Officer 3rd Class Spencer Mickler

Chilean Sub in Submarine Rescue Exercise

The Chilean submarine *CS Thomson* (SS-20) participated in the Diesel Electric Submarine Initiative (DESI) Program under the aegis of the U.S. Submarine Forces from August to November 2010. In addition to the usual tactical exercises to hone the U.S. Navy’s capability against the growing diesel-electric threat, *Thomson’s* 44-member crew also joined the San Diego-based Deep Submergence Unit in a submarine rescue exercise. *Thomson* bottomed herself on the ocean floor at approximately 450 feet to simulate a submarine casualty. DSU members aboard an ocean-going tug then deployed divers in atmospheric diving suits and lowered a pressurized rescue module (PRM) on a tethered line. The PRM performed a successful open-hatch mating with the visiting sub as it would in an actual submarine rescue.

USS *Houston* Participates in Exercise Keen Sword 2011

Japanese and U.S. P-3 Orion patrol aircraft fly over USS *Houston* (SSN 713) on Dec. 10, 2010, the final day of Exercise Keen Sword 2011. Keen Sword 2011 capped the 50th anniversary of the Japan-U.S. “alliance of equals,” a key strategic relationship in the Northeast Asia Pacific region.



Photo by Petty Officer 3rd Class Adam K. Thomas

2010 Submarine Sailors of the Year

Commander, Submarine Force Atlantic (COMSUBLANT) and Commander, Submarine Force Pacific (COMSUBPAC) selected the 2010 Submarine Sailors of the Year from over 17,000 members of the Submarine Force, both afloat and ashore, based on professional performance, leadership skills, and military bearing.

COMSUBLANT awards both Senior and Junior Sailors of the Year. The Senior Sea Sailor of the Year was Petty Officer First Class Gabriel Gerling, a nuclear-trained machinist's mate assigned to the Blue crew of USS *Wyoming* (SSBN 742). Senior Shore Sailor of the Year went to Petty Officer First Class Jarrod Hancock, a submarine-qualified sonar technician assigned to the Trident Refit Facility in Kings Bay, Ga.

COMSUBLANT's Junior Sea Sailor of the Year was Petty Officer Second Class Kevin Dale, a submarine- and diver-qualified electrician's mate from USS *Norfolk* (SSN 714). Junior Shore Sailor of the Year went to Petty Officer Second Class Gregory Yanase, an electronics technician assigned to the Naval Ocean Processing Facility in Whidbey Island, Wash.

COMSUBPAC's Sea Sailor of the Year was Petty Officer First Class David Tejada, a submarine-qualified yeoman from USS *Asheville* (SSN 758). Shore Sailor of the Year went to Petty Officer First Class Stacey Mincey, a legalman assigned to Commander, Submarine Group Seven.

The four senior winners will advance to compete against nominees from other communities in their respective fleets.



(Right, top to bottom) Vice Adm. John Richardson, Commander, Submarine Force Atlantic, congratulates *(from top to bottom)* Petty Officer 1st Class Gabriel Gerling, Petty Officer 1st Class Jarrod Hancock, Petty Officer 2nd Class Kevin Dale, and Petty Officer 2nd Class Gregory Yanase. All photos by Petty Officer 1st Class Todd Schaffer.

(Below) Petty Officer 1st Class David Tejada and Petty Officer 1st Class Stacey Mincey with Submarine Group Nine Commander Rear Adm. Robert Hennegan *(far right)* and Submarine Force Pacific Force Master Chief David Lynch *(far left)* after receiving COMSUBPAC's Sea and Shore Sailor of the Year (respectively) Feb. 25. Photo by Petty Officer 2nd Class Shannon Warner.



Naval Submarine League's

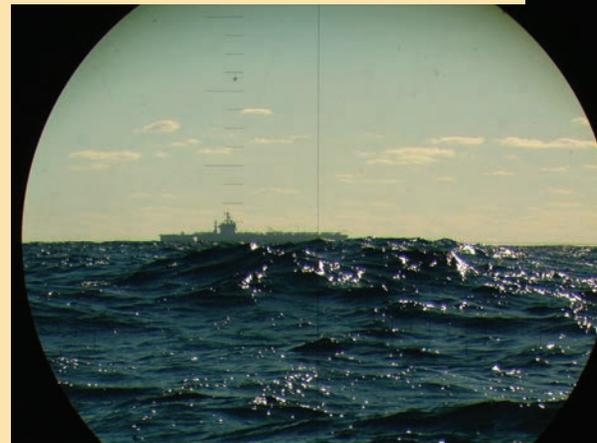
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Submit your submarine-related photos to UNDERSEA WARFARE Magazine,
which will publish a selection of the best entries in the Fall 2011 issue.

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Submit all entries by August 1, 2011. Photos must be at least 5" by 7", at least 300 dots-per-inch (dpi)
and previously unpublished in printed media. Limit of five submissions per person.

E-mail photos in JPG or other digital formats to underseawarfare@navy.mil, or mail printed photos to:

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Submarine Museums and Memorials



Photo courtesy of the Royal Navy Submarine Museum



Photo courtesy of the Royal Navy Submarine Museum

The Royal Navy Submarine Museum

Gosport, England

The Paterson Museum in Paterson, N.J., displays the first crude boats built by American submarine pioneer John Holland. But where can you see an example of Holland's first really successful design, the one for the U.S. Navy's first commissioned submarine, USS *Holland* (SS-1)? Why, at the Royal Navy Submarine Museum in Gosport, England, just across the harbor from the great British naval base at Portsmouth!

The Royal Navy acquired its first submarine in 1901. A slightly improved version of the original *Holland*, His Majesty's Submarine Torpedo Boat Number 1, shown above, was built in Britain under license from America's fledgling Electric Boat Company. Rapid advances in submarine technology made the early *Holland* boats obsolete in less than a decade. The Royal Navy sold Boat Number 1 for scrap in 1913, but she sank accidentally while under tow and never reached the scrap yard.

The wreck was discovered in 1981, salvaged and put on display at the Royal Navy Submarine Museum. When the initial preservation work proved inadequate, the museum undertook a costly stabilization program, enclosing the sub for four years in a fiberglass chamber filled with sodium carbonate to leach out the chloride ions corroding the metal. It then installed the boat in a carefully climate-controlled facility.

The sub's exterior is largely unchanged, although it does show the effects of decades underwater. Her interior was stripped before she went to the breakers, but her torpedo tube remains in place, as does her propulsion plant, including the gasoline engine,

electric motor and propeller shaft. The exhibit even includes an original battery cell.

The museum has a number of historic submarines on display. The most impressive is HMS *Alliance*, an advanced World War II submarine that serves as a memorial to the 5,300 British submariners who have given their lives to the service. Completed too late for the war, *Alliance* received a technology upgrade comparable to the U.S. GUPPY (Greater Underwater Propulsion Power) program and continued to serve until 1973. After years on display in the salt air with the tides impacting on her casing, she is now in need of major preservation work, and the museum is currently raising funds through the Saving HMS *Alliance* Appeal to preserve her for future generations.

For fans of special operations, the most intriguing exhibit is undoubtedly the midget submarine X-31. This is the only remaining example of the "X-craft" that sneaked into a Norwegian fjord to cripple the German battleship *Tirpitz* and penetrated Japanese defenses at Singapore to sink an enemy heavy cruiser (see the article on page 24 of this issue).

A world-class submarine museum and a must-see for any visiting American submariner, the Royal Navy Submarine Museum can be reached from the city of Portsmouth by taking the Gosport Ferry from a pier near the Portsmouth Harbor train station. In the summer months, there is also a waterbus that links the historic Dockyard directly to the Submarine Museum. For more information visit <http://www.submarine-museum.co.uk>, or find the Royal Navy Submarine Museum on Facebook.