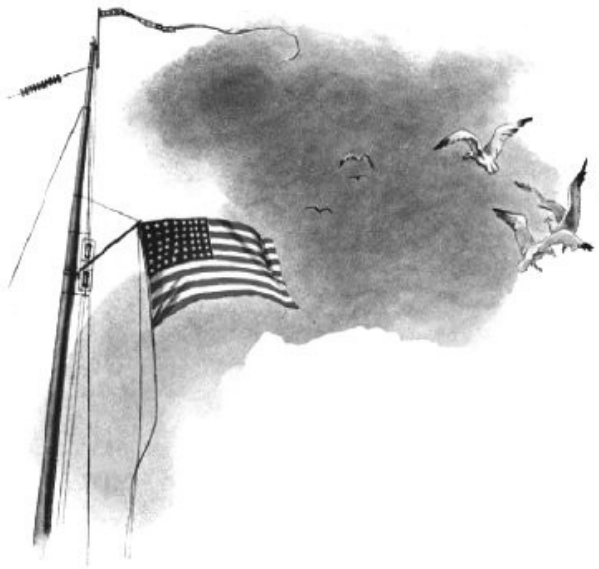
August, 2003
Volume 9 - Issue 8

Midwatch

Arizona Sub Vets Perch Base

http://perch-base.org

What's "Below Decks" in the Midwatch



Lest We Forget Those Still On Patrol

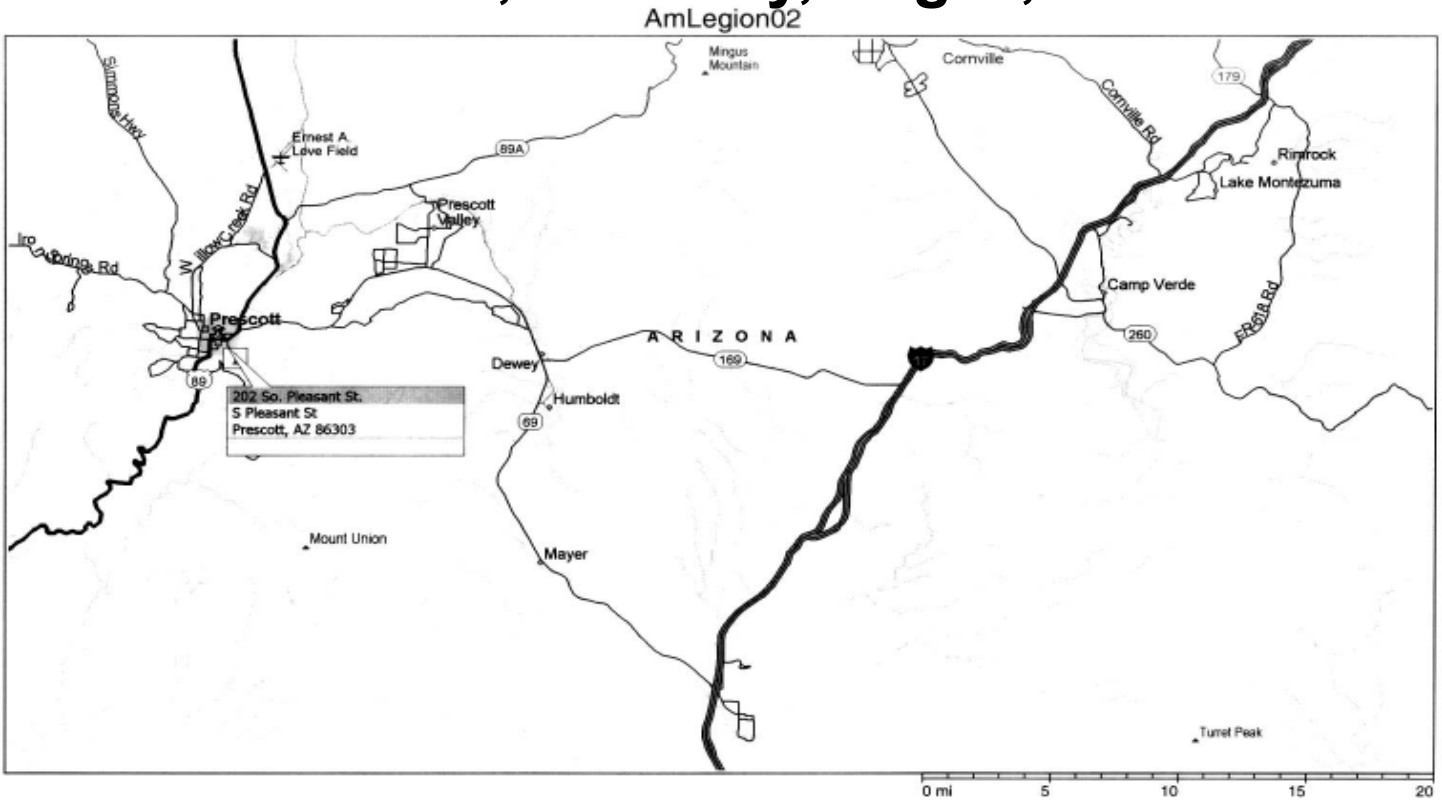
AUGUST ETERNAL PATROLS

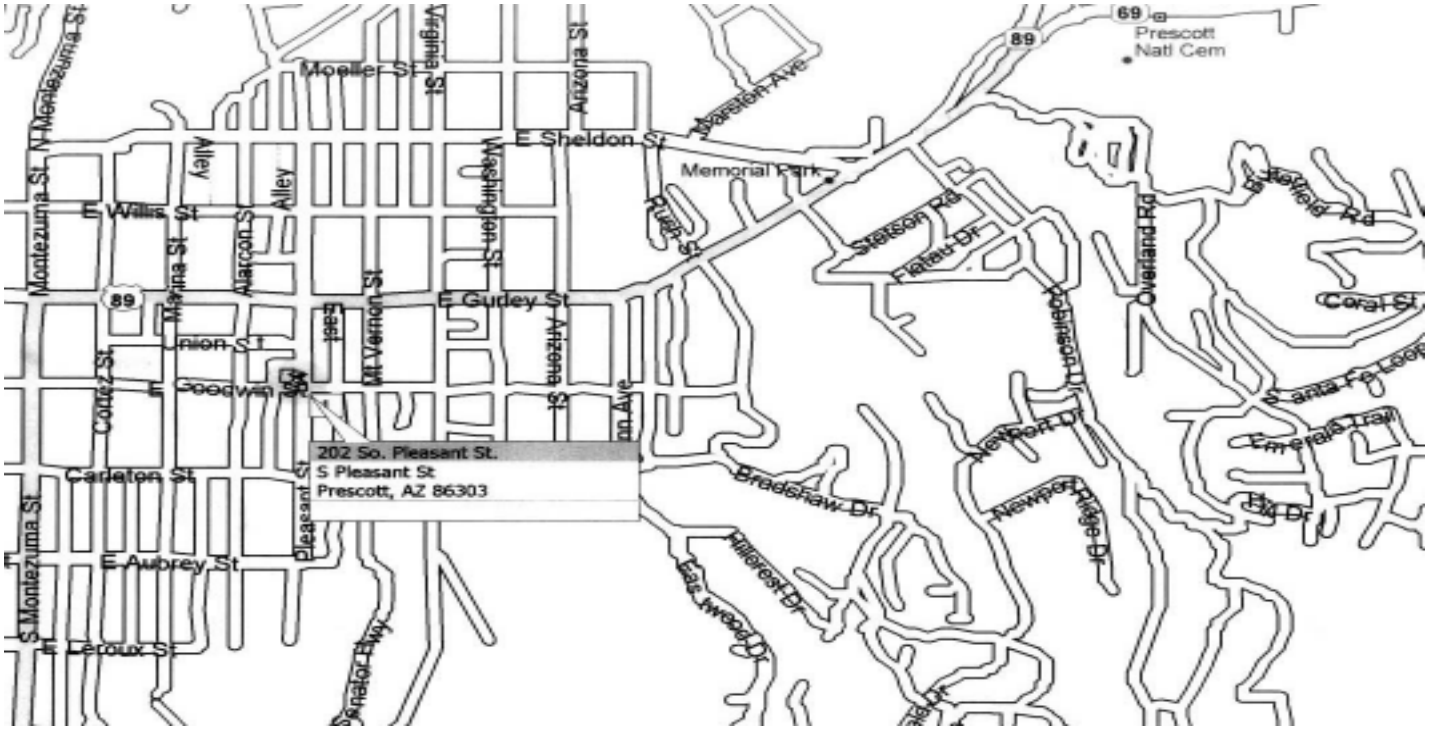
USS Bullhead	SS332	Aug. 6, 1945	84 men
USS Flier	SS250	Aug. 13, 1944	78 men
USS Grunion	SS216	Aug. 16, 1942	70 men
USS S-39	SS144	Aug. 16, 1942	none lost
USS Harder	SS257	Aug. 24, 1944	79 men
USS Cochino	SS345	Aug. 26, 1949	(see note)
USS Pompano	SS181	Aug. 29, 1943	76 men

NOTE: Although Cochino lost no men in its sinking, 7 men from the USS Tusk were lost in the rescue of Cochino's crew.

DON'T FORGET!
Next meeting is August 9
American Legion Post #6 - Prescott
202 S. Pleasant St

August Meeting
Prescott, Saturday, Aug. 9, 2003.





DIRECTIONS:

Take I-17 north to Exit 262 (Arizona Hwy 69.) Follow Hwy 69 into Prescott — stay left after passing the Prescott Resort and Bucky's Casino. Hwy 69 merges into Hwy 89 and is Gurley Street in Prescott. Follow Gurley to the light at Pleasant Street. Turn left on Pleasant. Follow Pleasant to the corner at Goodwin Street. American Legion Post #6 is on the right. Park in front along the street or, if spaces are available, in the rear of the post.

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Sailing Orders

August Meeting is in Prescott Saturday, Aug. 9, 2003. See the maps, page opposite, for directions.

Latest information - Joint National Convention
Reno, NV September 2 - 5, 2003

Host base (USSVI): CORVINA Base, Reno - Don Brown, Co-chairman
Host chapter (USSVWWII): Las Vegas Chapter - Paul Dornberg, Co-chairman
Host hotel: Reno Hilton, booked full, reserve now in other hotels!
Approximately 45 boat reunions are planned!
All of the convention functions (with the exception of the golf outing) will be held at the host hotel.

"See You In September"

S.S. Lane Victory tour in San Pedro Harbor (LosAngeles) on Sept. 13.

From the Wardroom

From the Ward Room;

Shipmates,

Next meeting will be in the cool pines of Prescott, at the American Legion Post. I hope we will have a great turn out for this meeting. Bring your wife, friend or significant other, I am sure they will enjoy getting out of the Valley and feeling the change in temperature.

Our new auxiliary unit, The Sub Vettes are off and running with Nancy Nelson and Kay Harnish leading the way. Please, shipmates, let your wife read this newsletter, and let them know we seek their help and support with our ladies auxiliary the Sub Vettes. Hopefully this will allow us to have a better turn out to our meetings and get togethers.

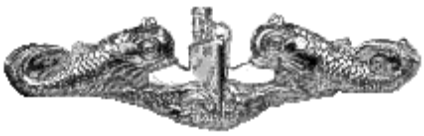
This past Tuesday, several of us attended the General Meeting of American Legion Post # 62. Our district Commander, Dave Harnish, and I presented to the Post Commander, two checks from Sub Vets of Arizona and the Pigboaters totaling $ 1500.00 for their building fund. Thanks to the Pigboaters for kicking this donation to the building fund off. We have made an impression on the members of the American Legion Post # 62.

We have another project under way, thanks to a kind message sent to me by Roy Purtell of the USS Sea Owl Association, the group that purchased the "PERCH BRICK" before we could. It is a current list of the survivors from the USS Perch SS176 that are still with us.

Our project will be to contact each survivor by mail, and make them an honorary member of Perch Base, along with our patch. And to let them know that our National Cemetery has a USS PERCH SS 176 monument, dedicated to them and their departed shipmates. Hopefully we might get a chance to shake their hand and thank them for our freedom.

Shipmates these survivors are truly our heroes. I am sure I speak for all of us, when I say we cannot do enough for them.

Fraternally Yours,
Glenn Herold
Base Commander



July Meeting Minutes

Minutes of a Meeting
of the Arizona Submarine Veterans - Perch Base

The regular monthly meeting of the members of the Arizona Submarine Veterans B Perch Base was convened at the American Legion Post #62; Peoria, AZ at 1304 hours, 12 July 2003. The meeting was called to order by the Base Commander – Glenn Herold.

Warner Doyle, Base Chaplain led the members in a prayer of Invocation. Roger Cousin then led the group in a "Pledge of Allegiance" followed by Adrian Stuke reading the "Purpose of the Organization".

The members were then led in Dedication and Moment of Silence for our departed shipmates followed by the "Tolling of the Boats" ceremony for submarines lost during the month of July.

According to the sailing list, there were 26 existing members, 3 new members and 6 guests attending the meeting.

The members welcomed new members – William Tippett, Richard Simmons and Jim Edwards. The members also greeted Shipmate Hubert Maxey and his friend and caregiver Kathleen. William, Richard and Jim briefed the membership on their interesting backgrounds and experiences following which they were welcomed to Perch Base with a round of applause.

The members also welcomed guests; Kay Harnish, Nancy Nelson, Brandi Hershey, Gary Caraker and Harry Chapman.

A motion was made and seconded that the minutes from the June meeting be approved as published in the Base Newsletter, "The MidWatch." The motion carried by voice vote of the members present.

Treasurer, Robert May, reported the Base's financial status as of the first day of July, 2003.

A motion was made and seconded to accept the Treasurer=s report as read. The motion carried by unanimous voice vote.

REPORTS BY OFFICERS AND COMMITTEE CHAIRMEN

Vice Commander – Adrian Stuke and Dave Harnish briefed the members on the Board's selection of engraved name tags to be offered through the ship's store. The engraved plastic nametag would sell in the ship's store for

$13 and the metal tag with sterling silver dolphins would sell for $20. Samples of the two nametags were passed around to allow the members to view them.

The Chief of the Boat had nothing to report.

Perch Base Chaplain, Warner Doyle announced that Shipmate Jim Strassells was recovering from triple by-pass surgery and was doing well. He also announced that Roger Cousin's wife Lee had recently undergone surgery and was home recovering as well. Shipmate, Don Wannamaker is at home and being cared for by his wife Judy, who is currently being assisted by hospice personnel. Everyone was encouraged to keep those who are ill or infirm in their prayers.

Membership Chairman, Ramon Samson, reported that the Base now has 135 members plus the three new members at today's meeting. Ramon again attributed recruitment of many of the new members to the National web site and its link to Perch Base's web site.

As Web Master, Ramon also announced that the new vest offered by the Ship's Store would be featured on the Web page. There will also be a new link to the personal library of John Welsh who lends books to SubVets.

Midwatch Editor, Chuck Emmett, indicated that in order to get the newsletter to all the members in a timely fashion, all input would have to be in by two Fridays before the next monthly meeting.

Base Storekeeper, Jim Nelson, illustrated some of the new items available in the Ship's Store especially the new vest available from a local supplier.

OLD BUSINESS

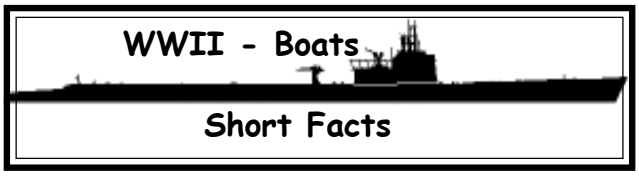
Glenn Herold reminded members that the August 9 Base meeting would be at the American Legion Post in Prescott.

Dave Harnish reminded members of the cruise on the SS Lane Victory and requested that anyone wishing to participate get their reservations and payment in to him by July 18.

Dave also reported that the members of the Pigboater's Chapter of the Submarine Veterans – WWII had cast a final vote to donate $1,000 to the American Legion Post #62 and that the Perch Base Board of Directors had voted to add another $500 to that.

The Pigboater's Chapter had also purchased a maintenance kit for Perch Base to use in maintaining the plaques at the submarine memorial of the National Cemetery.

Everyone was once again encourage to notify the Base Chaplain when some one was ill or hospitalized so he could make contact and stay abreast of their progress.



The longest patrol made by a U.S. sub during WWII was by the Guitarro. Her third patrol was 83 days.

NEW BUSINESS

Dave Harnish announced that USSVI has established a National Ladies Auxiliary called the Subvettes. They have elected a National President and slate of officers as well. Dave also introduced a motion that the members authorize a gift of $50 to the National Ladies and another $100 to the recently formed Perch Base Ladies Auxiliary. The motion was seconded and passed by voice vote of the members present.

Nancy Nelson also announced that there would be an application form printed in the next newsletter and encouraged all the wives to become members of the Perch Base Ladies Auxiliary.

Glenn Herold made a motion that Hubert Maxey's friend and caregiver Kathleen be granted associate membership in the Ladies Auxiliary. The motion was seconded and passed by a voice vote of the members present.

Ramon Samson announced that the Board of Directors had approved a Perch Base Life Membership and the design for a special card to be issued to Perch Base Life Members. Dues for life membership in the Base will be the same as the cost for becoming Life Member of USSVI based on a person's age.

Dave Harnish reminded the members that the time is running out to make reservations and application to attend the National Submarine Veteran's Convention in Reno, Nevada. Hotels are filling up as well as the RV Parks. The convention starts on September 2 and ends on the 5th.

GOOD OF THE ORDER

Ed Brooks announced that Kay Harnish and Nancy Nelson were raffling a set of hand carved dolphins to raise money for the Pigboater's Ladies Auxiliary. One Hundred tickets were to be sold at $1 each. All the 100 tickets were

(Continued on "MINUTES," page 6)

(continued from "MINUTES," page 5)

sold at the meeting and the drawing held. The winner of the dolphins was Sue Caraker.

Dave Harnish notified the members that the American Legion Post 62 was moving ahead with their plans to build a new building and hoped to break ground near the end of this summer. Everyone was encouraged to become active members of the Post.

50/50 DRAWING

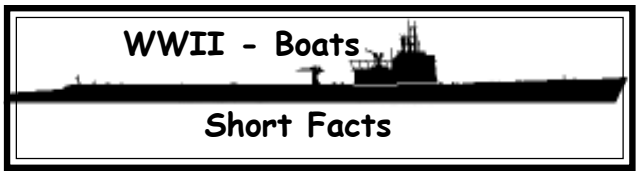
The 50/50 raffle was conducted and Royce Pettit was the winner. The winner's share of the drawing was $40. Royce donated the winnings to the Base treasury.

ADJOURNMENT

All the outstanding business being concluded, it was moved and seconded that the meeting of the Arizona Submarine Veterans - Perch Base be adjourned. The motion carried by voice vote.

The meeting was adjourned at 1400 hours.

Signed: Edgar T. Brooks, Base Secretary)



As far as can be determined, not a single United States merchant vessel was sunk in error by U.S. submarines during World War II.

The I-17, a Japanese submarine made the only attack against an American mainland target when she shelled the oilfields at Santa Barbara, CA on July 18, 1942.

Eternal Patrol
Aug. 24, 1944

Editors Note*: **Less we forget, each month, one boat on eternal patrol will be highlighted in this newsletter. Sailors, rest your oars.***

U.S.S. Harder (SS-257)
79 men lost

Commander S.D. Dealey guided his eminently successful fighting ship, HARDER, out of the harbor at Fremantle, Australia on 5 August 1944 to begin the sixth war patrol of that vessel. In company with HAKE, HARDER conducted training exercises en route to Darwin. These two submarines topped off with fuel at Darwin, and on 13 August, together with HADDO, left for their assigned area west of Luzon, P.I. They were to patrol as a coordinated attack or wolf pack group, with Cdr. Dealey in charge.

On the afternoon of 20 August 1944, RAY, patrolling the same area, tracked a large convoy into Paluan Bay on the northwestern coast of Mindoro. An hour after surfacing, she contacted HARDER just outside the bay and held a megaphone conversation with Sam Dealey. Dealey formulated a plan for concentrated dawn wolf pack attack on the convoy. HARDER came alongside HADDO at 0130 on the morning of August 21 and told Lt. Cmdr. C.W. Nimitz, Jr., that at least 16 enemy ships were holed up in the bay. When the convoy made its exit at dawn (as convoys were wont to do) RAY was to approach from the northwest, HADDO from the west, and HARDER from the southwest. GUITARRO also had been drafted by Dealey, and was to attack from the northwest near Cape Calavite Lighthouse.

During the attacks which ensued, four ships, totaling 22,000 tons, were sunk, by Japanese admission. It is thought likely that HARDER sank one of them.

On the following day, HADDO and HARDER conducted a

(See "HARDER," on Page 8)

This Old Boat . . .

Last month's "This Old Boat" threw some curves. Is was indeed the U.S.S. Growler. But unless you have better eyes than this old sailor to see hull numbers, it could have been the Grayback. Ed Brooks and Royce Petit gussed correctly and Stan Reinhold guessed the Grayback. Both Ed and Royce had some good insights and are truely "Masters of Arcane Knowledge."

Chuck:

The mystery submarine in the July issue of the "Midwatch" is the USS Growler SSG-577. The submarine that I served longest on was the USS Halibut SSGN-587. Both the Halibut and the Growler carried the Navy's first successful guided missiles (the Regulus I).

From 1960 to the end of 1964 the Regulus was the only nuclear warhead equipped missile brandished by the U.S. Navy submarine force. Of course, the commissioning of the USS George Washington SSBN-598 changed the nature of the U.S. Navy's deterrent arsenal and abruptly ended the Regulus missile program. As everyone knows, the Halibut went on to become an intelligence platform and the U.S.S. Growler was decommissioned. U.S.S. Grayback SSG-574 was converted to an AGSS submarine troop transport.

Halibut, Grayback, Growler, Tunny and Barbero made up the Pacific submarine deterrent force from 1960 to 1964. All of them made numerous deterrent patrols in the north Pacific. Halibut carried 5 Regulus missiles, Grayback and Growler both carried 4 and Tunny and Barbero carried 2 each. All were diesel powered except Halibut who had an S4W nuclear reactor and steam propulsion system.

The ramifications of having a diesel propulsion systems, the range of the Regulus missile and the target assignments made it necessary for the diesel boats to snorkel almost continuously for the more than 1-1/2 to 3 month patrols. All this time, they were within range of the Soviet Union's main anti-submarine port (Petropovlovsk).

Many of the folks that rode these boats have total submerged times in hours equaling years. We reviewed the Quartermaster's logs on Halibut and totaled the submerged time. I personally had the equivalent of more than a thousand days submerged.

The Regulus missile patrols made by the five boats operating out of Pearl Harbor have been all but ignored because of the short period (4 years) they were undertaken.

Ed Brooks

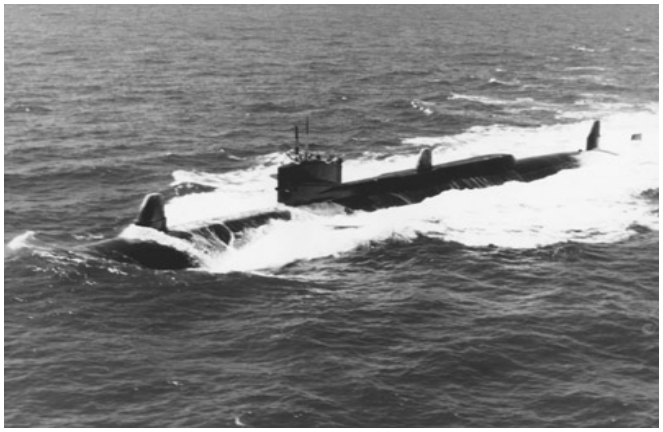
Again, why the old? Historic, perhaps. . . . . .

Two names immediately came to mind, both SSGs. The Grayback (574) and Growler (577) were look-alikes. I have seen a picture of Grayback after she was converted to a LPSS, and she had a topside rudder then, so let's just say it was the SSG predecessors of the Halibut.

Keep the bubble steady!

Royce Petit

We've had way too many shipmates guessing correctly. Keep this up and I'll "doctor" the photos to put camouflage paint on the hulls. But try your luck on this one.



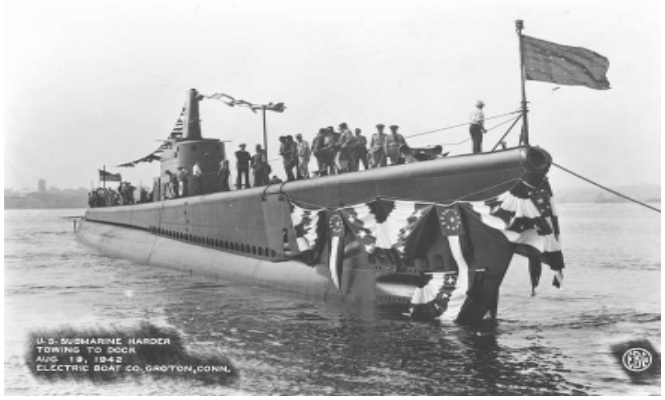
Do you recognize this old boat?Send your answer to the editor
chuckster41@earthlink.net

Need a book about submarines?
Have you checked out our base library?
It's easy. Find the book online at:
http://perch-base.org/perch_base_library.html

HARDER (continued from page 6)

combined attack on three small vessels off Bataan. All three were sunk; these were the coast defense vessels MATSUWA, SADO and HIBURI. HADDO and HARDER each received credit for sinking one vessel, and shared credit for the third sinking.

The morning of 23 August HADDO contacted a tanker escorted by a destroyer, and blew the bow off the destroyer in a down-the-throat shot. She fired her last torpedo in this attack, and in response to urgent calls for assistance, HAKE and HARDER rendezvoused with her. HADDO, being out of torpedoes, "received Sam's blessing" and left his wolf pack, heading south. HAKE and HARDER discussed plans for finishing off the damaged destroyer and then departed for their common objective off Caiman Point.



At 0453 on the morning of August 24th, HAKE dove not far from Caiman Point and about four miles off Hermana Major Island, west coast of Luzon, with HARDER in sight 4500 yards south of her. HAKE heard echo ranging to the south and soon sighted two ships. At first they appeared to be a three-stack light cruiser and a destroyer, but upon later inspection were identified as a three-stack Thai destroyer (the PHRA RUANG, of 1,035 tons) and a minesweeper of less than 1,000 tons. HAKE broke off the attack and headed north when the target zigged away apparently to enter Dasol Bay, while the minesweeper stayed outside.

At 0647 upon coming to a northerly course, HARDER's periscope was seen dead ahead at about 600-700 yards. Sound also reported faint screws on the bearing, so HAKE turned away toward the south. At this point the minesweeper gave three strong pings, whereupon HAKE saw her 2,000 yards away swinging toward the two submarines. HAKE figured he had sound contact and went deep. The enemy kept pinging, but seemed to have the two targets located and to be undecided what to do about it. At 0728, HAKE heard 15 rapid depth charges, none close. Two sets of screws were heard and each continued pinging on either quarter of HAKE as she evaded to the westward. By 0955 all was quiet.

HARDER never was heard from again. Japanese records reveal that an antisubmarine attack was made on the same day with 440 pound depth charges. The enemy said, "much oil, wood chips and cork floated in the neighborhood." Presumably, HARDER perished in this depth charge attack.

HARDER was officially credited with having sunk 20.5 enemy ships (the half credit was given for a ship sunk cooperatively with HADDO). This gave HARDER a total of 82,500 tons sunk and she damaged seven ships for 29,000 tons.

Her first patrol was conducted in Empire waters, starting in June 1943. She sank three freighters, and damaged seriously a freighter-transport, another freighter, a transport and a tanker. She went to the Empire again for her second patrol, and sank three freighters and a tanker, while she damaged a trawler.

HARDER was a part of wolf pack, of which PARGO and SNOOK were the other members, on her third patrol. In the open sea north of the Marianas, she sank a freighter, three freighter- transports and an armed trawler.

HARDER's fourth patrol was in the western Carolines. On April 1, 1944 she made a daring rescue of a Navy fighter pilot shot down at Woleai Island early that morning during a strike by a fast carrier task force. In mid afternoon on April 13, 1944 she was buzzed by a Japanese patrol plane which brought the destroyer IKAZUCHI to the scene. The DD was attacked and sunk along about sunset. Four nights later she sank a freighter and damaged a second destroyer.

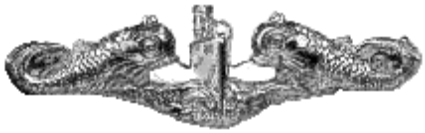
HARDER departed Perth for her fifth patrol in the Celebes Sea on May 26, 1944. She picked up coast watchers from northeastern Borneo, and gave a very valuable contact report on a major task force leaving Tawi Tawi anchorage, Sulu Archipelago, preparing to engage in the first Battle of the Philippine Sea.

Shortly thereafter, while patrolling in the Tawi Tawi area she sank five destroyers over a five day period beginning on June 6, 1944. First to go down was MINAZUKI, followed the next day by HAYANAMI. Three days later on the 9th, she sank the TANIKAZE and another unidentified DD during the same attack; and sank another unidentified DD on the 10th.

Sinking of these last two unidentified DD's could not be verified shortly after the war by the Joint Army Navy Assessments Committee, but subsequent analysis of the data, published in 1989 by the U.S. Naval Institute, has supported the initial claim. Moreover, Sam Dealey and

others in the fire control party observed the sinking of the fourth DD; and the fifth DD broke up almost on top of HARDER after being hit with a down the throat shot. By the time HARDER returned from this patrol, she had earned the reputation of being the Submarine Force's most terrible opponent of destroyers. Indeed, "five DD's in five days" was electrifying news throughout the submarine force."

HARDER received the Presidential Unit Citation for her first five patrols, and Commander Dealey was posthumously awarded the Congressional Medal of Honor for sinking five enemy combatant vessels on his outstandingly successful fifth war patrol.



Perch Base Contribution

Perch Base Commander Glenn Herold and Past Commander Dave Harnish give a check for a building fund contribution to the Commander of American Legion Post 62. The check represents the Base's desire to help in the Legion Post's building fund.

SHIPMATES COLUMN

EDITOR: I'm continuing to run small facts, or "factoids," on submarines in World War II throughout the newsletter as "WWII Boats - Short Facts." I'm still running those that Shipmate Jim Newman was kind enough to send them and I'll run the until they're gone.
But Shipmate Bob Mate has lent me a book, "Subs Against the Rising Sun" by Keith M. Milton, that also has factoids I'll run.
I'm getting more and more input and THAT'S GOOD. This is your newsletter.

Do you have any information to share with shipmates? Contact the Midwatch Editor, Chuck Emmett at:

(602) 843-9042
chuckster41@earrthlink.net

FIRSTMATES COLUMN
Perch Base Wives

SUBVETTES of PERCH BASE would like to extend a special THANK YOU to Dave Harnish for all his help with our Constitution & By Laws, which have been approved by the National SUBVETTES President Ella Blado. Without Daves help this would not have been accomplished so quickly.

"Atta' boy Dave"

WWII - Boats
Short Facts

United States submarines performed a total of 298 special missions which included delivering ammo, money and supplies to guerillas, evacuating key personnel, reporting weather, taking pictures, landing raiding parties, rescuing stranded aviators, doing pre-invasion recon work, laying mines, bombarding certain areas for G-2, landing secret agents, and sweeping minefields.

Chaplain's Column

Several shipmates and/or wives are in sick bay at this time. Our thoughts and prayers are with them:

Jim Strassel
- Jim's home now

Lee Cousin
- Roger's wife is doing fine. See her gracious note, below.

Don Wanamaker
- Don is home. Please call first if you wish to stop by and see him. Ramon Samson has been staying in touch with Don. You might want to check with Ray first.

Do you have know of any shipmate who's sick or the wife or family member of a shipmate? Contact the Base Chaplain, Howard Doyle:

(6232) 935-3830
d-hdoyle@worldnet.att.net

A Thank you to the crew

I can't tell you gentlemen how much I enjoyed receiving the flowers you sent after my breast surgery. Talk about "pick me ups"! Roger is right, *you are a certain breed.*

Thank you, and lots of love,

Lee Cousin

SUBVETTES ANNOUNCEMENT

We are pleased to announce the formation of the National Organization:

SUBVETTES
Ladies of the US Subvets Inc.

Our plan is to have our own local **SUBVETTES** of **PERCH BASE** up and running in the next month or two.

We are very fortunate and need to give thanks to our LADIES of the WWII Pigboaters Chapter, who are so very supportive in our efforts toward our goal.

Special thanks to Betty Weber, State Commander for the WWII Ladies, and Sandy Bernard, President of the Ladies Chapter of Pigboaters, for being willing to be a part of our organizing. They have been successful for almost 50 years with their own Auxiliary, and we are so lucky to have them as part of our membership.

Any Ladies interested, are requested to contact Kay Harnish or Nancy Nelson for information. Membership applications are available in this News Letter, by mail, e-mail & we will have them at the August Meeting in Prescott.

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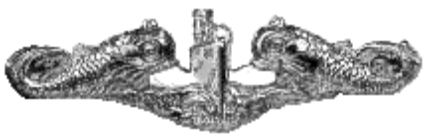
kharnish@earthlink.net

Nancy Nelson
(623)972-1044
nancyn@nationalbrands.com

Sue Shumann
Membership Chairperson
garry1@cox.net



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Submarines of the Future

Where "Boats" Are Going

Jane's Defense Weekly
June 25, 2003
Submarine for the Future: Up from the Deep

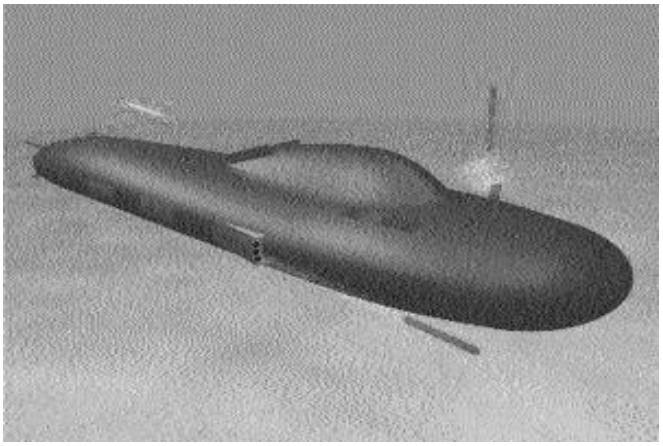
The submarine of the future may differ greatly in aspect and function from today's systems. Richard Scott reports on the US Navy's aspirations for a stealthy, multi-mission undersea platform able to play a full part in tomorrow's network-enabled battlespace. As he looks to the 21st century challenges, Adm. Frank 'Skip' Bowman, the US Navy's Director, Naval Nuclear Propulsion, sees "five key areas of innovation which we'll need to work on in order for submarines to continue to evolve and maintain the capabilities needed to carry out the broad and significant roles we are being called to perform:

In simple terms, we need to do more to get connected, get payload, get modular, get electric and, meanwhile, remain affordable".

The remarks of Adm. Bowman clearly articulate the main thrusts of the USN's future vision for its nuclear-powered fast attack boat (SSN) force. Notwithstanding the fact that the service's senior submariners remain adamant that the mandated 55-boat force is insufficient to take on all the tasks demanded of it, there is an imperative to expand the role of the SSN in the littoral environment and increase its contribution to joint expeditionary operations. The dissipation of the Cold War threat has not in itself reduced the need for submarines, says Adm. Bowman, but it has changed the nature of submarine operations. "The continued capabilities of our submariners to succeed tomorrow will depend on the vision and ability of the Submarine Force to rapidly incorporate technological innovation in order to maintain our margin in a fast-paced technological environment and to optimize the war fighting capabilities of the submarine platform."

But how should the future submarine look and function? It is a question that has been asked many times before. For example, in 1948 the USN asked the National Academy of Sciences to form a committee on undersea warfare to study the concept of a submarine designed primarily to maximize submerged performance. In response, the academy returned recommendations for the construction of a high-speed submarine capable of exceeding 20kt while submerged, based on a teardrop-shaped hull form, a single screw and HY-80 steel for the hull. The result was USS Albacore, still revered as one of the most revolutionary and influential designs in submarine history. In 1997, the Department of Defense (DOD) once again turned to the scientific community for help in determining the way forward for the submarine. The DoD charged a Defense Science Board Task Force (DSBTF), drawn from the research, scientific, operational, academic and industrial communities, to examine the operational utility of the submarine in the naval force structure up to 2020, analyze submarine and submarine force mix options, consider current limitations and possible capability enhancements, and draw conclusions as to where investment should be targeted in the context of both technologies and missions.

When their report, "Submarine of the Future", emerged in July 1998, it offered an insightful - and, in parts, radical -



view of the submarine's potential contribution to future US defense needs. Significantly, in pointing out that near-term design decisions will have a major impact over the next half century, it called for the traditional emphasis on improving propulsion and acoustic quietening to be relaxed in the near term. Instead, it argued that the main thrust of future development should be put into improving connectivity, sensors, weapons, 'adjuvant' vehicles, and the so-called ocean interface. SSNs were held up by the Task Force as "a key and enduring element of the USN's current and future naval force - a 'crown jewel' in America's arsenal". But the panel also noted that current

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designs were beholden to a number of increasingly significant constraints that limited their operational flexibility. For example, the submarine has always traded on unrivalled stealth as its unique selling point, but this self-same attribute has traditionally limited levels of connectivity - anathema in today's increasingly network-enabled battlespace.

In its assessment of this dichotomy, the DSBTF advocated pragmatism. While acknowledging that new missions and concepts of operations will demand much improved connectivity with other forces, it argued that the importance of stealth - "the sine qua non submarine attribute" - would inevitably result in some compromise.

"We believe sufficient connectivity should be the goal, not connectivity as good as other ships. In particular, exposing antennas to be part of a 'morning' video teleconference should not be considered."

Then there is the issue of the ocean interface. Stowage, composition and deployment of weapons and other payloads remain bound by the 'tyranny of the torpedo tube'. The taskforce suggested that a successor to the Virginia class should not have torpedo tubes, vertical launch silos, or any other weapon-specific interfaces with the water. Rather, it advocated "a flexible interface which does not constrain the shape and size of the weapons, auxiliary vehicles and other payloads". 'Submarine of the Future' also noted: "The submarine will have to shoulder a wider responsibility than that of a torpedo boat and, to enable that, our key recommendation is that the torpedo room be exorcised and the front-end rearranged to create an open [free-flooding] space patterned after a cargo hold or, more aptly, a bomb bay. That will remove the design constraints of 25in [635mm] hatches and 21in ejection tubes." According to the DSBTF panel, introducing the 'bomb bay' innovation should form part of a wider re-engineering of the submarine 'front end'.

This would also encompass the elimination of the sail (to gain speed and maneuverability at shallow depth in high sea state and to reduce noise) and replacing current sonar sensors with a new integrated array (offering much improved performance).

Another key issue addressed by the taskforce was submarine operational availability. Attempting to reconcile reduced boat numbers with a higher operating tempo, it recommended increasing time on station of deployed boats, "not so much to reduce budget pressure by reducing the number of SSNs, but rather to increase global presence of the submarine force in emergencies with so few total platforms". It added: "We believe that improvements can lead to nearly continuous deployment of the hulls, with crew rotations taking place in forward areas. That eventuality has to be incorporated in today's design practices - reduced maintenance needs, reduced crew size, novel logistics support, automation/simulation, and especially a flexible ordnance load out to adapt easily to a variety of missions."

Three key recommendations emerged from the study:

1. First, that the Virginia-class SSN program should continue and evolve.

2. Second, that the USN should examine ways to improve the utility and availability of its SSNs, and that these improvements should be consistent with the taskforce's emphasis on evolving the submarine's 'front end'. And,

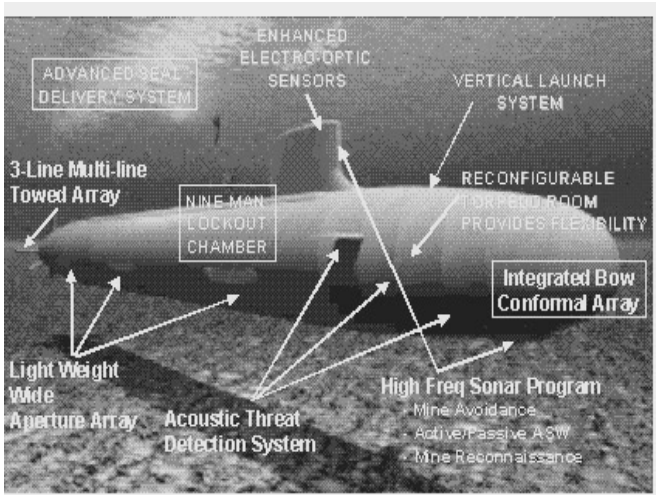
3. Third, that the Defense Advanced Research Projects Agency (DARPA) and the USN should engage in a co-operative effort to develop new payloads, encourage greater participation and innovation from industry, and create new performance metrics.

In the wake of 'Submarine of the Future', the USN and DARPA signed a memorandum of understanding to study future SSN design concepts, paying particular attention to advanced payloads and sensor systems and the attendant implications for platform design (excluding propulsion). DARPA managed the so-called Submarine Payloads and Sensors effort in co-operation with the Naval Sea Systems Command's (NAVSEA's) Director of Submarine Technology. Under the Submarine Payloads and Sensors effort, two industry consortia - Forward PASS (Payloads and Sensors for Submarines), headed by Raytheon; and Team 2020, led by Lockheed Martin - were given funding to explore novel approaches to the future submarine, with an emphasis on payload interchangeability and modularity. Encouraged to think 'out of the box', the two teams considered a wide range of futuristic concepts that were evaluated to assess their contribution to future joint force missions. General Dynamics' Electric Boat Division took a position in both camps, leaving it able to offer its submarine design expertise to ensure the technical feasibility of individual design solutions. Between them, Forward PASS and Team 2020 came up with a range of novel ideas addressing both payloads and their attendant impact on future submarine designs.

These included: extended overland intelligence, surveillance, reconnaissance and targeting through the deployment of small-size unmanned air vehicles (UAVs) and off board ground sensors; development of encapsulated payload modules and modular magazines able to 'plug'

into standard interfaces; the use of small, low-cost precision weapons for prosecuting a wide range of target sets; and the integration of advanced unmanned undersea vehicles (UUVs).

For example, Forward PASS foresaw the concept of a Broaching Universal Buoyant Launcher (BUBL) to accommodate payloads in a capsule that can be released from a submerged submarine or other vehicle and then rise to the surface. BUBL could be mounted externally, housed in a free-flooding 'bomb bay' or carried within the pressure hull. Control of the launcher's ascent would allow the submarine to exit the area before weapon deployment. Another concept advanced by Forward PASS was the Multi-Payload UUV (MPUUV). Accommodated within the submarine, the MPUUV would be configured and fuelled in board before being deployed through a 'flexible ocean interface'. To perform a similar function to the BUBL launcher, Team 2020 proposed a Stealthy Affordable Capsule System developed by Northrop Grumman. It also developed the concept of a Flexible Payload Module, 2.4m2 and 7.6m deep, with the ability to be stacked in free-flooded areas or housed in a missile tube.



As a result of innovations put forward from the Submarine Payloads and Sensors project, the US Naval Sea Systems Command (NAVSEA) is now funding a number of technology demonstrations to test out the concept of the modular submarine payload encapsulations. This work, alongside research and technology development addressing selected intelligence, surveillance, reconnaissance and targeting (ISRT), decision support, data fusion, platform and propulsion improvements, will inform an evolving submarine that takes the new Virginia-class SSN as the baseline point of departure. Taking advantage of the latter's modular design philosophy; iterative improvements (or 'bundles') would be progressively introduced over time according to technological maturity, mission need and - crucially - budget availability.

One example is the Advanced Sail, a technology insertion currently planned for introduction from the seventh Virginia-class boat onwards. Fabricated from composite materials, the double-curvature, low-drag sail would yield reduced flow noise through its superior hydrodynamics while at the same time increasing available payload volume by a factor of about four. Other technology insertions being actively considered in envisaged 'bundles' include a conformal bow sonar array, greatly enhanced connectivity (through new higher data- rate antennas, and increasingly 'open' external communications architectures) and a new ISRT mast (possibly incorporating the ability to deploy a small UAV). Although the submarine 'front end' has been targeted for much of the USN's future investment, the service is also looking for improvements at the 'back end' in the form of an integrated electrical power system (interestingly, this was a technology area which the DSBTF concluded should not be an area prioritized for non-recurring investment).

Electric drive would allow for greater flexibility in the design of the machinery spaces, provide complete flexibility in the allocation of electrical power throughout the submarine and at the same time, yield improvements in acoustic stealth. In parallel with other DARPA and NAVSEA research initiatives, Electric Boat's own Concept Formulation group has been working to identify cost and performance improvements for future submarines. Adopting the Virginia class as its baseline, the company has studied technology-insertion opportunities, and has also explored expanding the number and diversity of payloads such as advanced UUVs. Electric Boat has also contributed its submarine design expertise to alternative future designs scoped by the Forward PASS and Team 2020 consortia as part of their respective submarine payloads and sensors efforts.

Meanwhile, Team 2020 has conceptualized a family of submarines. These extend from a so-called Virginia Plus (retaining the 10.35m hull diameter of the baseline Virginia class but lengthened to 124m to incorporate two payload bays) to the more radical Merrimack, Renegade 1 and Renegade 2 designs (all 'fattened' to a 12.8m hull diameter).

And looking into the distant future? Writing in the USN's in-house Undersea Warfare magazine, National Aeronautics and Space Administration scientist Dennis M Bushnell offered a vision of a future world where the proliferation of advanced sensors, weapons and information-processing infrastructures had rendered naval assets operating on the surface - or in shallow water - all too vulnerable to precision-targeted weapons. Only in the deep ocean could naval platforms find sanctuary. Bushnell's answer was an "almost spherical" deepwater 'arsenal' submarine combin-

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ing inherent survivability with immense firepower. "This shape would yield several synergistic benefits, including minimum wetted area and friction drag, plus the smallest structural weight for increased depth capability," he suggests. Other design features might include an onboard chemical plant for producing drag-reducing polymer from phyto- and zooplankton sieved from the power plant coolant intake, active acoustic masking to defeat low-frequency active sonars, and the incorporation of a replenishable burst-speed 'afterburner' system - perhaps a hydrogen-oxygen rocket - as an adjunct to a scaled-down main propulsion plant. "Admittedly, this concept submarine would be very different from what might result from continuing with our current and evolving design practice," says Bushnell. "However, along with affordability and survivability, volumetric loadout is the major issue for power projection from submerged platforms. An 'almost spherical' deepwater, arsenal submarine would have sufficient volume for many of the design options above; space for adjunct sensors, such as mini-UAVs; and large capacity for storing munitions."

SSN-23: laying the foundations

To some extent, the modifications being made to USS Jimmy Carter (SSN-23), the third and final Seawolf-class boat, will serve to realize new thinking on expanding the multi-mission utility of the nuclear attack submarine in the littoral battlespace. Modified during build by Electric Boat, Jimmy Carter will enter service in mid-2004 to support classified research, development, test and evaluation missions. The most significant adaptation is the new ocean interface section fitted aft of the sail. This hull insert features a 'wasp waist' (where the pressure hull 'necks down' into an hourglass shape) to provide significant additional volume outside the pressure hull but still inside the overall envelope of the submarine. This new ocean interface facilitates more flexible payload deployment/recovery, and imposes fewer constraints on the shape and size of weapons, vehicles, sensors and other payloads to be deployed from Jimmy Carter. Also, the boat is to be fitted with an advanced communications mast to support high-volume data connectivity.

The evolution of the SSN within the US Submarine Force will also be informed by experience from the Ohio-class nuclear cruise missile submarine (SSGN) conversion program. There are plans to modify four former Ohio-class ballistic missile submarines to serve as SSGNs, giving them the capability to deploy Special Forces and to fire Tomahawk land attack cruise missiles (TLAMs). Conversion to SSGN configuration entails the insertion of a seven-round cruise missile Multiple All-up-round Canister (MAC) into 22 of the 24 existing C-4 Trident missile tubes. This will enable a loadout of up to 154 TLAMs. Other missiles, such as a variant of the Army Tactical Missile System missile, may be fitted in future. The two remaining Trident missile tubes will be modified to serve as dual Special Forces trunks and lock-out chambers. Each trunk will accommodate dual five-person lock-out chambers and a system for mating with a Dry Deck Shelter or Sea, Air and Land special operations forces delivery vehicle. In the event of a tasking requiring a larger number of Special Forces, eight of the 22 tubes normally MAC-configured can instead accommodate modular reconfigurable stowage canisters for Special Forces equipment. Earlier this year, the Ohio-class submarine USS Florida played the role of an SSGN 'surrogate' in the USN's 'Giant Shadow' experiment, with members of the Forward PASS consortium supporting the trials effort. Conducted at the Atlantic Undersea Test and Evaluation Center in the Bahamas, the scenario-based experiment evaluated SSGN operations with intelligence, surveillance, reconnaissance and targeting systems (including a small UAV), demonstrated the utility of a large-scale UUV, saw the simulated employment of strike assets and replicated a representative command, control, communications, computers and intelligence network. Undersea vehicles: vital Unmanned Undersea Vehicles (UUVs) are a major 'breakthrough' technology for future submarine operations. According to Dr John Sirmalis, recently retired technical director of the US Naval Undersea Warfare Center (NUWC) and a leading proponent of unmanned vehicle technology, UUVs "will provide the capabilities for an expanded battlespace, with offboard communications and sensors enabling the undersea domain to join a net-centric battlespace. And, most importantly, [will provide] risk reduction to platforms and people". The USN already deploys a first-generation submarine-launched UUV for covert mine-reconnaissance tasks. Some of the 12 Future Naval Capabilities identified by the Office of Naval Research as focal points for future science and technology investment involve UUVs.

Three principal missions are identified: above-water intelligence, surveillance, reconnaissance and targeting; mine reconnaissance and tactical oceanography; and armed anti-submarine warfare (ASW). Each vehicle will also have the capability to operate as a net-centric node during its mission, providing connectivity between forward-deployed sensors and the battle group via acoustic, radio or satellite communications. The NUWC's vision sees Manta contributing in-theatre through all stages of an operation. Initially, some vehicles are deployed to perform above-water intelligence, surveillance and reconnaissance tasks near-shore, using optical, imaging, radar- and communications-band surveillance sensors. Others are employed to locate minefields. All data is transmitted to the battle group using low-probability-of-intercept communications (either a radio frequency or RF satellite or acoustic link). Then, just before the onset of full hostilities, Manta vehicles could be re-rolled to take on a more proactive offensive ASW mission. Deploying acoustic sensors in

high-risk shallow-water zones, they would first track and then prosecute threat submarines (using small, supercavitating weapons) before the latter have a chance to break out among the battle group.

Joint work carried out by the NUWC and Electric Boat has considered the carriage, launch, recovery and restraint of large externally stored UUVs on a submarine platform derived from the Virginia-class SSN design. The optimum long-term solution, according to the NUWC, is the carriage of four Manta vehicles (each carrying four heavyweight torpedoes) integrated conformally in a 'bottlenose' configuration. This is on the grounds that, as well as providing ample volume for the vehicles themselves, the 'bottlenose' also has a minimal impact on submarine hydrodynamic and hydroacoustic performance. A Manta Test Vehicle (MTV), about one-third scale, began trials in August 1999. Designed to serve as a testbed for future technologies and mission capabilities, the MTV is modular and reconfigurable, with a large payload capacity, an obstacle- avoidance system, high-accuracy navigation, acoustic communications, RF surface communications and low-speed control.

Future Studies Group examines new roles, technologies
Established in 1998, the US Navy's Submarine Future Studies Group (FSG) is chartered to "develop future concepts and goals necessary to enhance submarine superiority, with emphasis on revolutionary capabilities". Its broad terms of reference encompass the full spectrum of submarine roles and missions up to 2020, taking into account the future strategic environment, likely submarine missions over that time frame and the capabilities needed to execute them. It is noteworthy that the inclusion of junior officers within FSG seminars has been strongly promoted on the basis that they are not beholden to 'legacy thinking' that may block innovation. At the same time, the group enjoys high-level access to the Submarine Force leadership. To determine what capabilities future submarines will need - and, indeed, to justify their continued place - the FSG undertook an 'alternative future world' study to develop an informed forecast of the main challenges to be faced around 2020.These was identified as:

- proliferation of weapons of mass destruction;
- increased 'access' challenges;
- quiet, long-endurance coastal submarines will be the primary opponent;
- competition for information advantage in 'cyberspace' will proliferate; and
- littoral operations will dominate the area in which US submarines are required to operate.

To meet the challenges anticipated in the 2020 time frame, the FSG has identified key areas where existing submarine capabilities must be significantly improved. These include the ability to collect tactical information using off board vehicles and distributed sensors; the ability to maintain fully integrated connectivity with national and theatre commanders; and greater overall adaptability through modularity, increased system and mission flexibility, and an increased volume of firepower. The FSG has developed concept statements designed to provide long-term guidance to the submarine research and development program. The first of these addresses the need to improve, increase and expand payload capacity by "an order of magnitude" in comparison with existing SSN designs (a thrust following on from the USN/DARPA Submarine Payloads and Sensors effort). A second has considered future intelligence, surveillance and reconnaissance, paying attention to the potential benefits offered by new sensing capabilities (notably off board vehicles, network architectures and miniaturized sensors).

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